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PHILOLOGICAL STUDIES IN ANCIENT GLASS

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THESIS

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE
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UNIVERSITY OF ILLINOIS

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I HEREBY RECOMMEND THAT THE THESIS PREPARED UNDER MY
SUPERVISION BY Mary Luella Trowbridge
ENTITLED Philological Studies in ancient Glass

BE ACCEPTED AS FULFILLING THIS PART OF THE REQUIREMENTS FOR
THE DEGREE OF Doctor of Philosophy

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I. THE PURPOSE OF THIS STUDY

Since almost every important excavation adds something to the treasures of glass, it is not strange that archaeologists should find in the study of the objects themselves an unending source of interest. Consequently the history of glass has been admirably treated from an archaeological standpoint, most recently, for example, in the exhaustive study, Das Glas im Altertum by Anton Kisa. In the present study, therefore, there will be no use of the actual objects found, except incidentally; literary evidence alone will be considered, and that of all kinds. This, then, is a philological and historical study solely, intended to supplement from the side of written or inscriptional records the works on archaeology.

From the philological point of view the Greek words for glass will be treated;¹ from the historical both the manufacture of glass and its uses. In the first place, the purpose of this study is to take up chronologically the different Greek words by which glass was designated, such as kyanos, lithos chytē, hyalos, and krystallos, and discuss their etymology, orthography, derivatives and compounds, and meaning.

On the historical side the archaeologist can go back much farther than any one who is simply searching through written

¹I hope to discuss the Latin words for glass at another time.

records. By chemical analysis he can find out what materials were used; by an examination of actual objects he can tell how they were made; by the discovery of the glass ovens he can locate some of the chief manufacturing centers; from the amount of glass discovered, its particular variety and the place of discovery, he can draw conclusions as to the importance of the trade. The present study aims to supplement all this with what the Greeks and Romans themselves record of the manufacture of glass, of the story they tell of its origin, of the materials, where to obtain them and what proportions to use, of how to build the furnace and color and handle the molten glass, of the different kinds of glass and where they were made. And, furthermore, if it were not for literary evidence, especially the Roman law, there would not be even a glimpse of the social standing of the workmen who made these beautiful objects. From the classification of glass with precious metals, from the incidents recorded in history and from the laws, comes otherwise unobtainable evidence for the importance of the trade. Although the museums contain many glass objects not mentioned in literature, there are a few recorded in literature which are only known from that source, as, for instance, the use of glass compounded with other substances as a medicine. The different objects will be treated chronologically in the order in which they are first mentioned in literature.¹ Even if there are few

¹Of course this method of listing the uses of glass is without prejudice to the question of the relative date at which glass was actually employed for different purposes. Archaeological evidence is of prime importance to that aspect of the general problem, and literary evidence must in this respect be used with circumspection, since, strictly speaking, it affords usually only the terminus post quem.

new uses to be recorded, the incidents told about the objects may be of interest, and the date of the first recorded instance of employment for one purpose or another will have a certain degree of importance as a modest contribution to the history of material civilization. Throughout, then, in the historical part as well as in the philological, my aim is solely to supplement the study of actual monuments with literary evidence.

II. THE GREEK WORDS FOR GLASS

A. Kyanos

In Homer there is no instance of hyalos, the word by which glass was designated in later times, nevertheless glass in the form of paste or enamel was known and referred to by the term kyanos. It is mentioned in the description of the palace of Alcinous, about the bronze walls of which there ran a frieze of kyanos.¹ In the hut of Nestor there was a table with feet of kyanos.² Its use in the decoration of armor, however, seems to have been especially widespread. The breastplate of Agamemnon was inlaid with kyanos, gold and tin; the central boss of his shield was of the same material, as well as the snakes on his breastplate and baldric.³ On the shield of Achilles a ditch of kyanos ran about the vineyard.⁴ Somewhat later the author of the Shield of Herakles, a work of the Hesiodic school, speaks, probably in imitation of Homer, of 'zones' or 'concentric bands'

¹ Od. 7, 87 (86): χάλκεοι μὲν γὰρ τοῖχοι ἐλημένατ' ἔνθα καὶ ἔνθα, ἐς μυχὸν ἐξ οὐδού, περὶ δὲ θρυγκὸς κυάνοι. Schol. E on Od. 7, 87: κυάνοιο δὲ ὁ ἔχων τὴν βαθὺν ἀπὸ τοῦ κυάνου εἶνας βάμυρατος ὄντος κύανος, κυάνεος, κυανοῦν, ὡς χρύσεος, χρύσειος, χρυσοῦν. ὅπτις κυάνος ἐστὶ μέλας. Eust. 1570, 28: ὁ δὲ κύανος, χρώμα τὸ μέδαρέε οὐ τὸ κυάνειον μετουσιαστικῶς, ἀφ' οὗ κυάνεον καὶ κυανοῦν. κυάνεος δὲ θρυγκός τῷ τείχει, οὐδὲν οὐτις λεποδιεῖς τῷ μετέωρον φίνοιτο.

² Il. 11, 629 (628): ἦ σφιν πρῶτον μὲν ἐπιπροΐηδε τράπεζαν | κατὰν κυανό-πεζαν τεύχον. Cf. Schol. A. Eust. 867, 27: τὸ δὲ κυανόπεζαν μετὰ τοῦ τράπεζαν ἔχει μέρη τὸ κάλλος διὰ τὸ σῶμα κατάληκτον; δηλοῖ δὲ οὐ μόνον τὸν ἄποδον κυάνου ἔχουσαν πέζαν, σέστη τὸν ἔξω κύκλον, καθά φασιν οἱ παῖδες.

³ Il. 11, 24 ff.: τοῦ δὲ τοι δέκαδικος ἔστι μέλανος κυάνοιο, | δώδεκα δὲ χρυσοῦ καὶ εἴκοσι καποτέροιο | κυάνεοι δὲ δράκοντες δρωρέχατο προτὶ δειπνήν | τρεῖς ἐκάτερθ... ἐγδέσιοι δηλαδὲ εἴκοσι καποτέροιο | δευτέροις, ἐν δέκαδικοις ἔντι μέλανος κυάνοιο... τῆς δὲ ἐργυρεός τε λαμπῶν ἥτταρ ἐπ' αὐτοῦ | κυάνεος ἐλάσκτο δράκων. Eust. 828, 20: κύανος δὲ εἰς τὸ χρύσματος μέλανος, οὐδὲ τὸ κυάνειον, καὶ μφαρέτει τοῦ διερόντου κυάνεον, καὶ ἐν συναρρέστει κυανοῦν. Cf. Schol. BL on Il. 11, 24.

⁴ Il. 18, 564: ἀμφὶ δὲ κυανέντι κάπετον.

of kyanos upon the shield of that hero.¹

From the early poets no idea of the nature of this substance can be obtained, but something can be learned concerning its color and appearance. Homer calls the kyanos on the armor melas, 'black', which probably means no more than 'dark'. As an adjective or in compounds he uses it to refer to the hair,² the beard,³ the brow,⁴ the eyes,⁵ the clouds,⁶ the phalanx,⁷ the prows of ships,⁸ the sand of Charybdis,⁹ and the robe of Thetis.¹⁰ When the hair of Poseidon is mentioned, it would not seem altogether inappropriate to consider it as resembling the dark blue of the sea.¹¹ The eyes also of Amphitrite would doubtless be blue; but

¹ Hes. Sc. 143: κυάνου δὲ σὰ πτύχες ἡλίκλαυτο.

² Il. 22, 402 (401): ἄρφι δὲ χαῖται κυάνεαι πίτραντο. Cf. Eust. 1276, 26. Usually as an epithet of Poseidon, Il. 13, 563 (562): ἄρενήνων δέ οἱ αἰχνύνται κυάνοχαται ποσειράων, πιότολο μεγάρας. Cf. Il. 14, 390; 15, 174, 201; 20, 144; Od. 3, 6; 9, 528, 536. Of a horse, Il. 20, 224.

³ Od. 16, 176: κυάνεαι δὲ ἐγέροντο γενεάσεις ἄρφι γέρειον. Cf. Eust. 1798, 63; 1799, 1925.

⁴ Il. 1, 528, of Zeus: ἦ καὶ κυανέησιν ἐπ' ὅφρύσιν νεῦσε Κρονίων. Schol. BLV: κυάνεαι δὲ καὶ μέλαιναι καὶ καὶ καταπίνκτικαι. Cf. Il. 17, 209. Of Hera, Il. 15, 102. Cf. Eust. 1008, 2ff.

⁵ Od. 12, 60 (59), of Amphitrite: προτὶ δὲ αὐταῖς Κύμη μέγα σροχθεῖ κυανώπιδος Ἀρφιτρίτης.

⁶ Il. 5, 345 (344): καὶ τὸν μὲν μετὰ χεροῖν ἐρύσατο Φοῖρος Ἀπόλλων | κυανέη νεφελήν. Il. 16, 66. Cf. Eust. 1046, 9. Il. 20, 418; 23, 188. Cf. Eust. 1295, 34. Od. 12, 75. Cf. Eust. 1714, 5. Od. 12, 405; 14, 303.

⁷ Il. 4, 282 (280): τοῖαι δέ, Αἰάντεσσι διοτρεφέων αἰγηῶν | δῆμον ἐσ πόλεμον πυκκυλαὶ κέρυκτο φάλαγγες | κυάνεαι.

⁸ Il. 15, 693 ff.: ὡς Ἐκτωρ ἵθυσε νεὸς κυανοπρώροιο | ἀντίος ἀίγας. Cf. Il. 23, 852, 878; Od. 3, 299; 9, 482, 539; 11, 6; 12, 100, 148, 354; 14, 311; 22, 465.

⁹ Od. 12, 243 (242): ὑπένερθε δὲ γατα φάνεσκε | φέρρη κυανέη.

¹⁰ Il. 24, 94 (93): ὡς ἔραφωνισσα κάλυψη ἔδε σια θεάων | κυάνεον, τοῦ σ' οστερελάντερον ἐπλετο ζεύθος.

¹¹ Of course, sea-green, is also possible, but hair is seldom, if ever, greenish in appearance, and the southern seas, unlike these of the north, are predominantly blue, not green, in color.

in none of the other instances is there any suggestion of blueness. Some of them could be black, but all of the references convey at least the idea of darkness.¹ What then was this dark material used upon wall, shields, and table?

Theophrastus is the first to say anything about the nature of the substance. "Kyanos too," he writes, "is both natural and artificial, as in Egypt. There are three kinds of kyanos, the Egyptian, the Scythian, and third, the Cyprian. The Egyptian is best for the darker colors, the Scythian for the lighter.² The Egyptian is artificial. And those who write about the kings also record which king first melted kyanos so as to imitate the natural, and that when gifts are being sent by some from Phoenicia there is sent a tribute of kyanos, both unfired and burnt. And those who grind the pigments say that kyanos of itself makes four colors, the first lighter from the thinner parts, and the other darker from the thicker."³ As for the natural kyanos he speaks of two kinds, a lighter and a darker,⁴ from the color of which the sapphire is not far distant.⁵ It is

¹ The scholiasts on Homer and Eustathius had the feeling that kyanos was melas. In Greek literature kyanos and melas are applied to the same things, as the aegis, horses, hair, eyes, water, ships, and the like. See Ebeling, Lex. Homer. 1, 920 ff.

² Literally, "The Egyptian is best for the pure pigments; the Scythian for the weaker."

³ Theophr. de Lap. 55: Καὶ κύανος ὁ μὲν αὐτοφυῆς ὁ δὲ σκευαστὸς ὥσπερ ἐν Αἰγύπτῳ. γένη δὲ κύανου τρία, διαγύπτιος, καὶ σκύθης, καὶ τρίτος ὁ κύπριος. βέλτιστος δὲ αἰγύπτιος εἰς τὰ ἄκρα λειώματα, δὲ σκύθης εἰς τὰ ὄρα τερπεῖ, σκευαστὸς δὲ αἰγύπτιος. Καὶ οἱ γράφοντες τὰ περὶ τούς βαριδεῖς καὶ τούτοις γράφουσι, τίς πρώτος βασιλεὺς ἐποίησε χιτῶν κύανον τηρητήρεος τὸν αὐτοφυῆν, διώρα τε περιπεσθεῖ παρ' ἄλλων τεκαι ἐκ φοινίκης φόρον κύανον, τοῦ μὲν ἀπύρου τοῦ δὲ πεπυρωμένου. Φασὶ δὲ οἱ τὰ φάρμακα τρίβοντες τὸν μὲν κύανον ἐξ ἐκτοῦ ποιεῖν χρώματα τέτταρα, τὸ δὲ πρώτον ἐκ τῶν λεπτοτάτων λεπτότατον, τὸ δὲ δεύτερον ἐκ παχυτάτων μελάντατον.

⁴ Ibid. 31: Καλεῖται δὲ καὶ κύανος δὲ μέρη ἄρρνων δὲ θῆλας· μελάντερος δὲ δὲ ἄρρνων.

⁵ Ibid. 37: Καὶ δὲ καλούσι τάπερον· αὕτη γέρ μελαίνα οὐκ ἔγει πόρρω τοῦ κύανου τοῦ κύπερος καὶ πρασίτης.

found among metals¹ and contains a trace of a golden color,² which would give it a glistening appearance. Dioscorides mentions only the kyanos of Cyprus.³ Theophrastus is followed more or less accurately by Pliny in his Natural History, where in one place he uses caeruleum⁴ for kyanos and in another the transliterated form, cyanos.⁵ He adds little except that in his own day there was a preference for the caeruleum of Cyprus.⁶

Theophrastus had to be interpreted before his description could throw any light on the kyanos of the early poets. It was not until Lepsius⁷ by an interpretation of the Egyptian inscriptions and by chemical analysis identified the three kinds, that its nature was understood. This view of Lepsius was accepted and further developed by Helbig.⁸ They identified the natural

¹ Ibid. 51: εύρισκεται ση μάντα ἐν τοῖς μετάλλοις τοῖς ἀργυρείοις τε καὶ χρυσείοις, ἔντα σὲ καὶ ἐν τοῖς χαλκορυχείοις, οἷον ἀρρενικὸν, σανδαράκην, χρυσοκόλλα, μίλτος, ὥχρα, κύαρος. ἐλάχιστος σὲ οὐτος καὶ κατ' ἐλάχιστα.

² Ibid. 39: καὶ κύαρος αὐτοφυῆς ἔχων ἐν ξαυτῷ χρυσοκόλλαν.

³ Diosc. 5, 106: κύαρος σὲ γεννᾶται πέντε ἐν Κύπρῳ ἐκ τῶν χαλκουργῶν μετάλλων. οἱ δέ πλειστοὶ ἐκ τῆς αἰγαίας τείδος ἄρρον, εὐρισκόμενος κατέ τηνας σπιλαίωνες ὑποσκαφὰς τῆς Βαλάσσους, οἵτις καὶ διαφέρει.

⁴ N. H. 33, 161: caeruleum harena est huius genera tria fuere antiquitus: Aegyptium maxime probatur; Scythicum mox diluitur facile et, cum teritur, in quattuor colores mutatur, candidiorem nigrioremve et crassiorem tenuioremve; praefertur huic etiamnum Cyprium.

⁵ Ibid. 37, 119: reddetur et per se cyanos; accommodato paulo ante et iaspidi nomine a colore caeruleo. optima Scythica, dein Cypria, postremo Aegyptia. adulteratur maxime tinctura, idque in gloria est regum Aegypti; adscribitur et qui primus tinxit. dividitur autem et haec in mares feminasque. in-est ei aliquando et aureus pulvis, non qualis sappiris; in his enim aurum punctis conlucet.

⁶ By caeruleum the Romans understood a kind of pigment. See Blumner, Tech. u. Term., 4, 499 ff.; Thes. Ling. Lat. 3, 107.

⁷ Die Metalle in den ägypt. Inschriften (Abhandl. d. Berl. Akad. 1871, 69-79, 130 ff.)

⁸ Das homer. Epos, ed. 2, 100 ff.

kyanos of Scythia with lapis lazuli and the color obtained from it; the kyanos of Cyprus, the caeruleum Cyprium of Pliny, with the blue pigment found in crystals or in the earth near copper-beds, that is, azurite, a form of copper ore; the artificial kyanos of Egypt with glass-paste resembling the others in color. Since Cyprus, which was noted for its copper, was under Phoenician control for a long time, the unfired kyanos taken by them to the Egyptian king was identified with the azurite from the copper-beds. The next step was to conjecture that the kyanos of Homer's palace was an artificial blue glass-paste,¹ and this view was confirmed by the discovery of just such a frieze at Tiryns.² The decoration on the shields would naturally be of the same material. Since Cyprus was noted for its kyanos, it may be of some significance that the breastplate of Agememnon was a gift from Cinyras, king of that

As a substantive kyanos does not occur frequently in later literature and when it does, it is often clearly a reminiscence of Homer. Plato⁴ describes the Styx as having a color like that of kyanos. Eratosthenes'⁵ mention of "zones darker than shining kyanos" brings to mind at once the inlaid work on the

¹Ibid. 106.

²H. Schliemann, Tiryns, 284 ff.; Baumeister, Denkmäler, 3, Taf. 77; J. Van Leeuwen et M. Mendes da Costa, Homeri Od. Carm. on 7, 87; C. Schuchhardt, Schiemann's Excavations, 141 (Trans. by E. Sellers, 116); G. Finsler, Hom. 296; P. Kavvadias, Περιστοεική Αρχαιολογία, 193; E. Drerup, Hom. ed. 2, 51; Hall, Aeg. Arch., 198; 204.

Τροίνην νέφεσσιν ἀναπλεύσεσθαι ἔμελλον· Τούνεκά οἱ τὸν ἔβωκε χαριζόμενος βασιλῆς.

⁴Phaedo, 113 B ff. οὐ τούτου σὲ κῦ καταντικρὺ ὁ τέταρτος ἐκπίπτει εἰς τόπον πρώτον σειρόν τε καὶ ἄγριον, ως λέγεται, χρῶμα δ' ἔχοντα ὄδον οὐδεὶς κυανός, ὅν δὲ ἐπονομάζουσι Στύλιον.

Homerian shields. When kyanos was used for the adornment of surfaces, at first glass-paste was meant, later a kind of paint.

The latter would present a shining appearance and when applied to a quill,¹ it is spoken of as porphyrion, 'dark'. It was also used for painting walls² and little toy figures or idols.³ In the field of natural history kyanos is the name of a bird⁴ and of plants,⁵ applied no doubt because of their color.

If the glass-paste and azurite were called kyanos from their resemblance to lapis lazuli, the chief characteristic of kyanos would seem to be that of blueness. There is no reason to doubt that the kyanos of the poets was of that color. However, it is difficult to understand why the later use of the substantive and its derivatives and compounds does not convey solely that idea.⁶

¹ Crinagoras (Anth. Pal. 6, 229): Αλετοῦ ἀγκυλοχείδου ἀκρόπτερον ὅξεν σιδήρῳ γλυφθέν, καὶ βαπτισθεὶ πορφύρεον κυανῷ.

² Paus. 5, 11, 5: τούτων τῶν ἐρυμάτων ὅσον μὲν ἀπαντικρὺ τῶν θυρῶν ἐστιν, ἀλλά πταλ κυανῷ μόνον.

³ Luc. Lexiph. 22: ὃς νῦν γε ἐλελύθεις σαυτὸν τοῖς ὑπὸ τῶν Κοροπλάθων ἐσ τὴν ἀγορὰν πλαττομένοις ἐοικώς, κεχρωσμένος μὲν τῷ μίλτῳ καὶ τῷ κυανῷ, τὸ δὲ ἐνδοθεύπλακος τε καὶ εὔθρυπτος ὄν.

⁴ Arist. H. A. 9, 18, 21: ἔστι δέ τις πετραῖος ὡς ὄνομα κύανος· οὗτος ὁ ὄρνις ἐν Νισύρῳ μάλιστά ἐστιν, πολεῖται δὲ ἐπὶ τῶν πετρῶν τὰς φιλατριβάς. Τὸ δὲ μέγεθος κοττύφου μὲν ἐλάττων, σπιγγης δὲ μείζων μικρῷ. Τελανόποιος δὲ, καὶ πρὸς τὰς πέτρας προσαναβαίνει. Κυανοῦς δὲος. Τὸ δὲ ρύγχος ἔχει λεπτὸν καὶ μακρὸν, σκέλη δὲ φραγέα τῇ πιποῖ παρόροια. According to Thompson, A Gloss. of Gr. Birds, 103 ff., this was probably the wall-creeper, Tichodroma Muraria, L.

⁵ Meleager (Anth. Pal. 4, 1, 39 ff.); τοῖς δὲ ἄμφοι Αλεξάνδρεοι νεούσ δρπηκας ἑλαῖς, ἡδὲ Πολυκλείτου πορφυρένιν κύανον. Plin. N.H. 21, 68: in Italia violis succedit rosa, huic intervenit lilium, rosam cyanus excipit, cyanum aurarantus. The name is at present applied to Centaurea Cyanus, L. - the bachelor's button.

⁶ Compare in Latin the similar use of caeruleus, which is sometimes 'blue,' sometimes 'dark,' sometimes 'gleaming.' See the articles on caeruleus and cyaneus in Thes. Ling. Lat.

That these do not is clear from their use even by Homer, as well as in later writers. A few scattered references will serve to show the divergence of feeling concerning its color.

Although the outstanding characteristic of the derivatives of kyanos in Homer is darkness, in nearly every instance they are applied to something that glistens. The snakes of kyanos are even compared with rainbows¹ because of their bright, iridescent appearance. When Callimachus² uses kyaneos to describe pitch, he certainly thinks of it as black, but black and shining. Aristotle³ mentions kyaneos and melas side by side as if they were a little different. It probably means blue in Philostratus'⁴ description of the peacock fish, which is so named from its color, for the striking characteristic of the peacock's feather is the remarkable eye shaped patch of brilliant blue; but the quality of iridescence might also have been in mind, for the peacock's feathers have that quality too, as does pitch, with which, as we have just seen, Callimachus compares kyanos. The same divergence

¹ Il. 11, 26 ff.: κυάνεοις οἱ δράκοντες ὄρωρέχατο προτὶ δεερήν | τρεῖς ἐκάτεροις τρισσιν ἑολκότες. As a further development of this idea the rainbow itself is called kyanē. Cf. Dio Chrysost. Orat. 12, 414 R: ἡ τανύοντα κυανῆν τριν.

² Hekale, Col. 4, 49: κυάνεον φὴ πίσσαν.

³ Meteor. 15, 342 a, 34 ff.: τοῦ φωτὸς ἐκ κυανέου καὶ μέλανος. In drawing up a long list of the colors of painters Pollux also speaks of kyanos and black but not of blue, so kyanos almost certainly stands for dark blue here. 7, 29: τὰ οἱ χρώματα, ἀν δρείκελον, δστρεον, πρασινον, κροκοειδές, κυανούν, κινητόβαρι, ξανθόν, φαεόν, φλογόλευκον, λευκόφαλον, λευκόν, μέλαν, μέλαριβαφές. Apion, however, considers it the same as melas. Etym. Gud.: κυάνεον τὸ χρῶμα· καὶ τὸ μέλαν. Cf. Ludwich in Philologus, N.S. 28, 245.

⁴ Vita Ap. 1, 85: καὶ τοὺς ἔχθυς τοὺς τάως, οἵς οὗτος μόνος ποταρῶν τρέφει, πεποίκυνται οἱ αὔτους δρυνύκους τοῦ ὄρνιθος, ἐπεὶ κυάνεοι μὲν αὔτοις οἱ λόφοι, στικταὶ οἱ αἱ φολίδες, χρυσαὶ οἱ τὰ οὐρατά καί, δπότε ρούκοιν το, ἀνακλώμενα. On the color of the peacock cf. Dio Chrysostum, Oratio, 12, 11.

in color is found among the compounds of kyanos. Pallas is called "She of the kyanos aegis."¹ The son of Aegialeus, the Argive, is Kyanippos, 'Black-horse'.² When kyanos is used of water, the idea suggested is probably dark-blue gleaming where the reference is to the sea, but more likely nearly dark, or dark-gleaming, when used of fresh water.³ The vault of the heavens⁴ is probably thought of as blue, or possibly as gleaming, without reference to the exact hue.

In a study of glass it is impossible to consider in greater detail the later development of kyanos, its derivatives and compounds⁵, but a brief summary may be made from the lexicographers and etymologists of the fifth to the thirteenth centuries. In Hesychius the chief idea is that of darkness, if not of blackness, but he gives some instances where kyanos might be or is used to indicate blueness, as the color of the heaven.⁶ The same might

¹ Pind. Ol. 13, 100 ff.: κυάναγις ἐν ὄρρῳ κνώστοντι οἱ παρθένοι τόσα εἰπεῖν ἔσοξεν. Since the aegis was originally a goatskin, and every Greek must have felt that as he used the word, kyanos here can hardly mean anything but 'black' or 'dark'.

² Paus. 2, 18, 4: ἀπὸ μὲν δὴ Βίαντος βασιλεύουσι πέντε οὐρανοὶ επὶ γερεάς τέσσαρας ἐς Κυάνιππον τὸν Αἴγιαλεων.

³ Phryn. Praep. Soph. 78, 1 ff.: κυαναυγῆς θάλαττα, καὶ κυαναυγῆς οὐδωρ, καὶ κυαναυγῆς ποταμός. Cf. In a diptych from Cairo (B.C.H. 28, 208): κυανωπτὸν οὐδωρ. Compare Homer's 'dark water' (μέλαν οὐδωρ) used of the water of springs and rivers, on which see Ebeling, Lex. Homer. 1, 1038, col. 2, and the rivers called Melas, no fewer than ten in number, see Pape-Benseler, Wörterb. d. griech. Eigennamen, s. v. (in modern Greece also the Kephissos in Phokis is called Mauropotamos, 'Blackriver').

⁴ Synes. Hymn. 9, 45: σὺ δὲ ταρσὸν ἐλάσσος, | κυανάντυγος οὐρανοῦ | υπερήλασ νάτων, | σφαίρης δὲ ἐπετάσθης | νοερατεῖν ἀκηράτοις | ἄγαθῶν σὺν παγᾶ, | σιγώνενος οὐρανός.

⁵ For further references see the articles on κύανος its derivatives and compounds in Pape-Benseler, op.cit.; Roscher, Ausführ. Lex. der gr. u. rom. Myth.; Thes. Gr. Ling. S. V. Κύανος (κυανός).

⁶ Lex.: κυανή· μελάνη· φαὲν· | κυανέντοι· φαῖται, μελανάται· | κυάνεος· μέλας, σικοτεινός· | ἐλέλικτο δράκων μέλας ἐν τῷ αὐτῷ ορεί" (H.S. op. 528) | κυανέων· μαύρων, Αἴθιόπων, κυανόντων· | μελανόπους· | κυανός· θαλάττιον οὐδωρ. καὶ ὄρης· | κυανοχείτης. μελανόθρηξ. ποσειδῶν· | Σ. οὐπερκυάνεον· λιάν κυάνεον.

be said of Photius¹ and the Anecdota edited by Bachmann.² In the latter, however, there is an exception, glaukos is defined as 'white, kyaneos'.³ This definition is repeated in Suidas,⁴ the Etymologicum Gudianum⁵ and Zonaras.⁶ In none of the instances considered has there been any suggestion of whiteness but just the opposite, and Philoponus rightly lists kyanos among the colors more closely akin to black.⁷ Reference, however, has been made frequently to the gleaming of kyanos and it is very probable that at times it suggested simply something bright and shining. However, it may be but a definition of light-blue, light blue and glistening perhaps, for Plato says that a combination of kyanos and leukos produces glaukos.⁸ It is to be observed that kyanos (or kyaneos) is used merely as a gloss for glaukos, not for leukos, galakti eoikos, or the like, for in lexicographical definitions or synonyms, one cannot safely proceed upon the principle that things which are equal to the same thing are equal to each other, since it is not precisely 'the same thing' for which

¹ Phot. Lex. (ed. Porson): κυανέοι· μέλανες | κυανοχαῖτης· μελάνθρις· πορφυρόθριξ· ποσειςῶν | Σαρδόνιος γέλως... ἐπ' ὄφρους κυανέητιν.

² Anec. Gr. 1, 284, 8: κυάνεοι· μέλανες. 284, 10: κυανοχαῖτης· μελάνθρις· πορφυρόθριξ· ποσειςῶν.

³ Ibid. 185, 12: γλαῦκος: λευκός, κυάνεος. Cf. Hesych.

⁴ Suid. s. v. γλαῦκος: λευκός, κυάνεος.

⁵ Etym. Gud. (ed. Sturz, 126, 3): γλαῦκος, λευκός, κυανός, γάλακτις οικώς τὴν σάρκα καὶ τὰ ὄφρατα.

⁶ Lex. 438: γλαῦκος· κυανός, ἢ λευκός, ἢ πυρώδη τὰ ὄφρατα ἔχων.

⁷ On Aristotle's de Anima, 2, 406, 29: τὰ δὲ ἐγγυτέρω τοῦ μέλανος, ὡς τὸ κυανοῦν.

⁸ Tim. 68c: λαρπρῷ δὲ λευκῷ συνελθὼν καὶ εἰς μέλαν κατακορὲς ἐμπεισὸν κυανοῦν χρῶμα ἀποτελεῖται, κυανοῦ δὲ λευκῷ κεραυνυμένου γλαῦκος, πυρροῦ δὲ μέλανες πράσιον.

the several glosses are proposed. Glaukos clearly meant, 'blue-bright', 'gray-blue-bright', and it is probable that the gloss kyaneos may have arisen from the application of glaukos in some poetical passage to an object that was commonly called kyaneos, or vice versa, from which the glossographer's deduction, that these words are occasionally used as roughly equivalent to one another, would be justified. Such objects would be the sea, water in general, eyes, hair or mane (to all of which glaukos and kyaneos are actually applied). Zonaras¹ also gives the ordinary meanings for kyanos, as well as the Etymologicum Magnum.² It may be because of the deep shade of kyanos, which was called melas even in Homer and Theophrastus, that the idea of blueness gave way almost entirely to that of darkness. Or the original meaning may have been simply the dark-gleaming, which would be applicable to lapis lazuli because of its dark, glistening appearance (compare the passage quoted above where Callimachus compares kyanos to pitch).

When there is such a divergence among ancient writers in their conception of the nature and color of kyanos, it is not strange that modern scholars should be puzzled by the word. The attempt to compare it with the Sanscrit çjā-mi-s, 'black', has

¹ Lex. 1262: κυανοχαίτης, μέλανόθριξ. κυανὸν γάρ τὸ μέλαν, καὶ χαῖτης οὐ θρίξ. 1268: κυανόν. τὸ μέλαν.

² 542, 48: κυανός ἐκ τοῦ κύρα γίγεται κυμανός· καὶ ἀπορολῆτος Μ., κυανός, ὁ μέλας· κυάνεος, καὶ κυάνεος, καὶ κυάνεα τῆς κυάνεας. 641, 28: ψάμμῳ κυανέη ἀντὶ τοῦ κυανίζουσα. 692, 32: κυανοπρωίρους· καὶ παρὰ Σιρωνίδην, κυανοπρωίραν. 718, 33... ἔως τοῦ στορίου τοῦ Πόντου, ἔνθα εἰσίν καὶ αἱ κυάνεαι πέτραι.

been abandoned¹ and as yet the etymology is unknown.²

To summarize, then, it seems pretty certain that glass-paste was first called kyanos from its similarity to some natural stone or mineral. When actual glass in the common meaning of the term became better known, it was designated by new terms, because, no doubt, it was thought to be a different substance from kyanos. But the word by which glass-paste was originally known, went on developing new compounds and new derivatives which seldom, if ever, give any suggestion of material but rather of color, sometimes blue, sometimes black, usually simply the idea dark, glistening, iridescent, or dark-gleaming. This last may very well have been the original idea from which the others developed in two direction, one emphasizing the idea of darkness, the other that of glistening or gleaming.

¹ Benfey in G. Curtius, Gr. Etym. ed. 5, 546; 612.

² E. Boisacq, Dict. Etym. de la Lang. Grec. 527.

B. Lithos Chytē

For a long time the Greeks had no special word to designate glass in general. Although kyanos stood for a form of glass-paste, from the literary evidence there is no indication that it was applied except when the glass-paste was used in the adornment of surfaces. Very soon other uses for glass must have become familiar from imported wares and from the stories of travelers. A name was needed for new objects differing in form and color from the early kyanos. Herodotus speaks of the material of which they were made as 'molten stone,' lithos chytē.¹ It is difficult to say whether this name was applied to glass because it was formed from melted silicates or because after a process of melting, a product resembling precious stones or crystals resulted, but more probably the latter, since the silicates used were generally in the form of sand, which the Greeks would scarcely have called stone.

Since kyanos was first imitated in Egypt, it is quite appropriate that the first use of lithos chytē should be in connection with that country. Herodotus² says that about Thebes and Lake Moeris the people had sacred crocodiles which they adorned with earrings of glass and gold. The use of glass to imitate gems would be one of the simplest. Since hyalos occurs side by side with lithos chytē, the latter may have stood for some special variety. Possibly Plato³ is thinking both of glass and of some

¹W. Froehner, La Verrerie Antique, 4, thinks that Herodotus probably translated an Egyptian expression.

²2, 69: ἐκ πάντων δὲ ἔνα ἐκάτεροι τρέφουσι κροκόδειλον δεδιαγμένον ἐναυχειροῦθεα, ἀρτύματά τε λίθινα χυτὰ καὶ χρυσεῖς τὰ διτα ενθέψτες.

³Tim. 61 B: τὰ μὲν ἔλαττον ἔχοντα ὕστερος οὐ γῆς τό τε περὶ τὴν ὕστερον γένος ἀπαν σόσα τε λίθων χυτὰ εἰδη καλεσταί.

particular form of it, such as paste gems, when he uses the expression, "all the kinds of stones that are called molten," listing them together as having less water than earth, among the things subject to the liquifying effect of fire. Although this expression does not occur frequently in literature, it must have been fairly well established, for the last mention of it occurs over two centuries after the first. Perhaps Epinicus¹ considered a goblet of 'molten stone' more suitable for poetry than one of hyalos, which was certainly a more common term by his time.

Sometimes glass was called simply lithos (fem.), 'stone.' That appellation may have arisen later as an abbreviation of lithos chytē, or simply like the longer expression because of the resemblance of glass to natural substances of a vitreous appearance. In Aristophanes' Clouds² Strepsiades asks of Socrates, "Have you ever seen at the druggists' that stone, the beautiful, the transparent one, by which they kindle fire?" Socrates queries, "You speak of the hyalos?" To be sure, the nature of glass was not very well understood as yet, and hyalos, by which it was later universally known, was sometimes applied to other transparent substances. However, there is no particular reason to think that the burning-glass was of crystal³ here. To be sure, it is called a

¹ Apud Athen. 10, 432 C: γέροντα Θάσιον τὸν τε γῆς ἀπ' Ἀτθίδος | ξερίον μελίσσους τῆς ἀκραχόδου γλυκύντι συκυρκανήτας ἐν σκύφῳ χυτῆς λίθου.

² Nub. 766 ff.: ΣΤΡ. οὐδὲ παρὰ τοσοῦ φαρμακυπώλαις τὸν λίθον | ταῦτην ἔρακας, τὴν καλήν, τὴν διαφανῆ, Ιάφ' οὐτὸ πῦρ ἀπτουσι; ΣΠΚ. τὴν έαλον λέγεις; F. H. Blaydes, Aristophanis Nubes, 101, n. 767, has emended καλήν to χυτήν without any substantial justification.

³ To be sure there is a gloss on v. 766 in R and V: τὴν λίθον τὸν κρύσταλλον, but this is ambiguous for κρύσταλλος seems occasionally to have been used for glass (see below; among the Romans crystallum must often mean nothing more than glass, see Blümner, Tech. u. Term. 4, 386),

stone,¹ but that does not suggest a crystal any more than it does the other name for glass. In the Periplus of Scylax² the Phoenicians are described as taking the 'Egyptian stone' to the West Africans. From the first the Greeks seemed to connect the manufacture of glass with Egypt, and it is not surprising that it should be called simply the 'Egyptian stone.' Gems and other trifles of glass would be most profitable for trade among less civilized peoples.³ Four centuries later, in the Periplus of the Red Sea the Egyptians are spoken of as exporting to the Berbers many kinds of lithia hyalē⁴ made at Diospolis. In one instance they are called simply lithia.⁵ From the diminutive form doubtless the nature of the articles of trade is indicated. Probably there is a reference to the making of glass in Bekker's Lexica,⁶ where he

while the more elaborate scholia in R and V on v. 768 speaks unequivocally of glass, and with this view the opinion of modern scholars agrees, see Blümner, op. cit. 4, 383,4; Kisa, op. cit. 1, 166.

¹ Salmas. Plin. Exercit. 773 b A: Nec impedimento est quod λίθον vocat. Auctores passim vitrum sic appellant. Auctor peripei λίθιαν ὑαλήν ubique vocat. Quae alibi eidem dicitur ψέλος ἄργυρον... Inde et κρύσταλλος glacies, quam vocem pro vitro etiam quidam usurparunt.

² Scyl. Peripl. 112 (C. Müller, Geog. Gr. Min. 1): οἱ δὲ Φοίνικες ἔμποροι εἰσάγουσιν αὐτοῖς μόρον, λίθον Αἴγυπτίαν, ἄπρους ἔξαράκτους, κέραφον Ἀττικὸν καὶ χούς.

³ Blümner, Tech. u. Term. 4, 381 ff.

⁴ Peripl. Maris Erythr. 6 (ed. Fabricius): προχωρεῖ δὲ εἰς τοὺς τόπους ἑταῖρα βαρβαρικὰ ἄγραφα τὰ ἐν Αἴγυπτῳ γιγόμενα... καὶ λιθίας ὑαλῆς πλείονα γένη καὶ ὕδατος πουερίνος τῆς γινομένης ἐν Διοσπόλει. οἱ προχωρεῖτε δὲ εἰς αὐτὴν ὑαλῆν λιθία σύμφωκτος. ΙΙ: καὶ λιθίας ὑαλῆς πλείονα γένη.

⁵ Ibid. 10: προχωρεῖ δὲ εἰς αὐτὸ τὰ προειρημένα γένη καὶ σκεύη ἄργυρα, σιδηρά δὲ ἐλάσσονα, καὶ λιθία.

⁶ 5, 270: Κάρπενος: τὸ κατασκεύασμα, δπου ὅπταται ὁ κέραφος καὶ λίθος.

calls an oven "a contrivance in which earthenware and stone (lithos) are baked."

Sometimes lithos chytē is said to be an older name for hyalos.¹ It is not mentioned before Herodotus who also speaks of hyalos, although he could not have used the latter of actual glass. Before this time, however, Corinna used the adjectival form of hyalos and very soon the word occurs with the meaning 'glass.' It is true that lithos chytē is applied to glass later than hyalos, but the two words are used at the same time and occur side by side. The real reason for thinking that lithos chytē is the older expression is that it is a primitive, descriptive term, while hyalos is a shorter, more direct technical expression. Probably the Greeks were at first most familiar with glass in the form of small objects, like gems, beads and other trifles which are so easily exported. It is possible that, when glass became more common, hyalos expanded to embrace all of its forms and varieties while lithos chytē was still generally applied to the small objects for which it first stood, and in the shorter form of lithos or lithia it continued to be used for these articles of barter. Yet the case of the goblet shows that it too had broadened its meaning somewhat. In literature, however, there was never a time when lithos chytē was as common as hyalos, to which it eventually gave way entirely.²

¹A. Kisa, Das Glas im Altert. 164.

² ἄλιθος or ἄλιθος χυτόν as a designation for glass probably passed out of general use soon after the introduction of a technical term which was not so liable to ambiguity, for ἄλιθος was commonly employed to denote precious stones in general and in particular often means 'the magnet' (ἄλιθος, sc. Μαγνῆτης).

C. Hyalos

1. Etymology.-- With the introduction of transparent glass there came a new designation, hyalos, the origin of which is unknown. It is derived from hyein, 'to rain,' by the Greek lexicographers and etymologists.¹ Salmasius notes this derivation and considers that hyalos with the meaning 'wet' would be used in the sense of 'bright,' 'clear,' since objects which are wet are bright and shiny.² Some modern etymologists consider the derivation from hyein probable,³ notably Curtius, who says that "the substantive probably meant properly 'rain-drop'." Froehner thinks that it is more probably from hals, 'salt,' the upsilon standing for an old digamma.⁴ Blümner thinks that it was a foreign

¹Orion (ed. Sturz): οὐάλη. οὐαλος, παρὰ τὸ οὔειν ἐσχημάτισται, καθ' ὀρούστητα τῆς γινομένης συστάσεως, καὶ πήξεως τοῦ οὐδατος, οὐαλως ὀρούσας. Ήρακλείδης.

Etym. Gud. 538, omits the last word. Zonar. Lex. 1760: παρὰ τὸ οὔειν καὶ καθ' ὀρούστητα εἴραι τῆς γινομένης συστάσεως καὶ πήξεως (μίξεως DK) τοῦ οὐδατος. Etym. Magn. 774: οὐαλος... ἐτυμοδογετταίδε παρὰ τὸ οὔειν... ὀρούσας. Miller, Mélanges, 290: οὐαλος... παρὰ τὸ οὔειν καθ' ὀρούστητα. κτλ.

²Salmas. Plin. Exercit. 771 a, F: Graecis οὔειν est madidare, et humectare, πρέχειν, ὑγραίνειν. Inde οὐαλος, humectum. Sed et quae madidata sunt et aqua aspersa, ea lucent nitentque, ex eo factum, ut etiam οὐαλος pro lucido sumeretur. Hesych. οὐαλος λαμπρόν etc. Postea proprium hoc nomen factum vitri.

³Sonne (Kühns Zeitschr. 12, 359). Curtius, Gr. Etym. ed. 5, 604 (Trans. by A. Wilkins and E. England): "Root ο-ε- it rains, ο-ε-το- s rain. Skt. su(su-nó-mi) press out juice, sú-má-m milk, water, sky... We may with some probability place here also οὐαλος, οὐελος." Prellwitz, Etym. Wörterb. ed. 2, 473: οὐαλεος, οὐαλος gläsern, wasserklar!: οὐω". Thes. Gr. Ling. 8, 7.

⁴Froehner, La Verrerie, 6: "J'aimerais mieux prendre la voyelle ο pour un ancien digamma, ce qui nous ramènerait au sel minéral (ξαλ), Et cette étymologie n'est pas si maladroite, car le verre est une espèce de sel; des chimistes autorisés l'ont ainsi défini." This conjecture seems the most probable to Morin-Jean (Daremburg-Laglio,

¹ word. Some would derive it from the Coptic,² because the first mention of glass in Greek is in connection with the Egyptians. Others try to find some connection with the Latin vitrum,³ 'glass,' or the element sualo -- "transparent stone or the like."⁴

2. Application of Hyalos.-- Whatever may be the source of the word hyalos, it seems to have been introduced to designate transparent glass. Since the word was new and the substance which it designated rather unfamiliar, it is not strange that it should be applied to other substances of a vitreous appearance. That is just what happens in the first instance where the substantive occurs in literature. To be sure, the use of the adjectival form, hyalinos, by Corinna⁵ implies an earlier use of hyalos than those recorded. Unfortunately the passage from Corinna is so obscure that we can learn nothing about glass from it. In Herodotus there is a description of coffins of hyalos among the marvels shown by the Aethiopians to the spies of Cambyses. "And after this, last of

Dict. des Ant. Gr. et Rom. 5, 935) and Kisa, Das Glas im Altert. 3, 24, but it implies a knowledge of chemistry on the part of the early Greeks which is altogether improper for one to assume.

¹ Blümner, Glas (P. W. 7, 1385).

² Thes. Gr. Ling. 8, 9: "Σάλος fortasse ortum ex Aegyptiaco ουάλος· ουάλος, quod Lapidem pellucidum, non vero proprie Vitrum nostrum significat. Jablousk, Opusc. 1, 250." Becker, Gallus, ed. 2, Ex. 1 on scene 7.

³ L. Meyer, Handb. d. Gr. Etym. 2, 141: "Dunklen Ursprungs. Denkbar wäre ein Zusammenhang mit lat. vitro (vitrum), Glass" (Publil. Syr. com. 14)."

⁴ Boisacq, Dict. Etym. 996.

⁵ Phryn. 309: καὶ ἡ Κόπευρα τὸν Σάλινον παῖσα διέτειν.

all, they saw their coffins, which are said to be made of hyalos in the following manner: When they have dried the body of the dead, either according to the Egyptian or some other fashion, they cover it entirely with gypsum and decorate it with painting, making it as nearly like the figure of the person as possible and then they put about it a block of hyalos which has been hollowed out (they dig up a quantity of this of a kind easily worked). The corpse is in the middle of the block and can be seen through it, but it does not produce an unpleasant odor or anything else unseemly, and it has everything visible like the corpse itself. For a year those most closely related keep the block in their houses giving it the first fruits of everything and offering sacrifices to it. And after these things they take it out and place it near the city.¹ This passage has caused not a little perplexity. All are agreed that hyalos does not mean glass, but the substance for which it does stand is uncertain.² Although this whole account is probably

¹ Hdt. 3, 24: Πετὰ δὲ ταῦτα τελευταῖς ἐθεῖσαντο τὰς θῆκας αὐτῶν, αἱ λέγονται σκευάχεσθαι ἐξ οὐλοῦ τρόπῳ τοιωδεῖς. ἐπεὰν τὸν νεκρὸν ισχυρήνωσο, εἴτε δὴ κατὰ πέρ. Αἱ γύπτιοι εἴτε ὅλως κως, γυψώσαντες ἀπάντα αὐτὸν γραφῇ κοσμέουσι, κεφαλεύντες τὸ εἶδος ἐσ τὸ συνατόν, ἐπειτα δέ οἱ περιστάσοι στήλην ἐξ οὐλοῦ πεποιηκέντοι κοίλην (ἢ δέ σφι πολλὴ καὶ εὐεργός ὄρυσσεται). ἐν μέσῳ δὲ τῆς στήλης ἐνεώρ σιαφαίνεται ὁ νέκυς, οὐτε ὄδριν οὐδεμίαν ὄχαριν παρεχόμενος οὐτε ὅλο ἀκέκης οὐδέν. Καὶ ἔχει πάντα φαρερὰ δροῖσις αὐτῷ τῷ νέκυῃ. ἐν λαυτὸν μὲν δὴ ἔχουσι τὴν στήλην ἐν τοσούσι οἰκίοισι οἱ μάλιστα προσήκοντες πάντων τε ἀπαρχόμενοι καὶ θυσίας οἱ προσάγοντες· μετὰ δὲ ταῦτα ἐκκομίσαντες ξετάσσοι περὶ τὴν πόλιν.

² Belzoni, Researches, 236 (quoted in Thes. Gr. Ling. 8, 8): "Oriental alabaster." Thes. Gr. Ling. 8, 8: "crystal." Rawlinson, Herodotus, 2, 350: "It should be rock crystal; but no piece of this substance could be found large enough to hold a body. It may have been some vitreous composition, coating the stone coffins in the form of a mummy, some of which are found in Egypt." Compare Sayce, Herodotus, 1-3, 240, 7. Abicht, Herodotus, ed. 3, 3, 26: "Vielleicht eine Art Steinsalz." Vanicek, Gr.-Lat. Etym. Wörterb. 1046: "Glasporzellans." Blümner, Tech. u. Term. 4, 384: "Ein

fabulous,¹ it shows that Herodotus applied hyalos to a transparent material which was dug out of the ground, and also that the Egyptians or rather Aethiopians perhaps occasionally used some transparent substance about their dead. Ctesias² attests such a use, but his authority is very slight to begin with, and besides it is impossible to tell whether he meant that the Aethiopians used actual glass or not, for Diodorus by whom this passage has been preserved may have misrepresented him as much as he has Herodotus.³ Diodorus interprets hyalos as actual glass which was poured about the dead. He says that they made so much of it in Aethiopia that there was enough for every one.⁴ Strabo is probably taking the word of an earlier writer when he says of the Aethiopians, "some pour hyalos about the dead and keep them at home."⁵ In another place, he speaks of the body of Alexander having

natürliches, aus der Erde gegrabenes Material." Note 1: "Die Erklärer denken an durchsichtiges Glasporzellan, andere mit mehr Wahrscheinlichkeit an Bergkristall." Liddell and Scott, s.v. "Some kind of clear, transparent stone."

¹ Niebuhr, Vorträge über alte Gesch. 1, 151; Rawlinson, Herodotus 2, 350, 2; How-Wells, A Comm. on Herodotus, 1, 240, 7.

² Diod. 2, 15, 2 ff.: Κτησίας δ' ὁ Κνίδιος ἀποφανόμενος τοῦτον σχειώνειν, αὐτός φησι τὸ μὲν σῶμα ταριχεύεσθαι, τὸν μέντοι γε ὕδωρ μὴ περιχετεῖνται γυμνοῖς τοῖς σώμασι· κατακαυθήσεσθαι γάρ ταῦτα καὶ λυμανθέντα τελέως τὸν ὅμοιότητα μὴ δικίγεσθαι διεκτηρεῖν. διὸ καὶ χρυσῆν εἰκόνα κατασκευάζεσθαι κοίλην, εἰς δὲ ἐντέβεντος τοῦ νεκροῦ περὶ τὴν εἰκόνα χετεῖνται τὸν ὕδωρ· τοῦ δὲ κατασκευάσματος τεθέντος ἐπὶ τὸν τάφον σίᾳ τῆς ὑέλου φανῆναι τὸν χρυσὸν ἀφωμολωμένον τῷ τετελευτικότι.

³ Ibid. 2, 15, 1: Ταφάς δὲ τῶν τελευτησάν των ἴδιων οἱ κατὰ τὴν Αἰθιοπίαν πολοῦνται· ταριχεύσαντες γάρ τὰ σώματα καὶ περιχέαρτες αὐτοῖς πολλὰν ύδωρ ἴστασιν ἐπὶ στήλης, ὥστε τοῖς παρειοῦσι φαίνεσθαι σίᾳ τῆς ὑέλου τὸ τοῦ τετελευτικότος σῶμα, καθάπερ Ἡρόδοτος εἴρικε.

⁴ Ibid. 2, 15, 4: τὸν δὲ ὕδωρ πάσιν ἐξαρκεῖν σίᾳ τὸ πλείστην γένναθειν κατὰ τὴν Αἰθιοπίαν καὶ τελέως παρὰ τοῖς ἐγχωρίοις ἐπιπολαζειν.

⁵ Strabo, 17, 2, 3: τοὺς δὲ νεκροὺς οἱ μὲν εἰς τὸν ποταμὸν ἐκρέπτουσιν, οἱ δὲ οὐκοὶ κατέχουσι περιχέαρτες ὕδωρ.

been changed from a gold to a glass sarcophagus.¹ Aelian² relates how Xerxes found the body of Belus in a glass sarcophagus full of oil. Such stories sound extremely fabulous. Lucian³ ascribes to the people of India the practice of smearing the dead with hyalos,⁴ an expression which surely suggests a substance other than glass. The Pseudo-Callisthenes⁵ describes the body of Cyrus in a coffin with glass poured about it. The Latin version of Julius Valerius⁶ where the coffin is described, uses the expression lapide visendo, 'of transparent stone.' There seems then to have been a custom among the Egyptians, Aethiopians, and Eastern nations of covering the bodies of the dead or the cases in which they were enclosed with something transparent, called hyalos. This could not have been a stone, for it was 'smeared,' or 'poured,' nor could it have been glass or even a glaze, because that cannot be poured except at

¹ Ibid. 17, 1, 8: τὸ δὲ σῶμα τοῦ Ἀλεξάνδρου κομίσας δὲ πτολεμαῖος ἐκκένευσεν ἐν τῇ Ἀλεξανδρείᾳ ὅπου νῦν ἔτι κεῖται· οὐ μὲν ἐν τῇ αὐτῇ πυέλῳ· οὐδέντιν γάρ αὐτῇ, ἐκεῖνος δὲ ἐν χρυσῷ κατέθηκεν.

² Var. Hist. 13, 3: Πάρεργος δὲ Δαρείου πάις τοῦ Βαύλου τοῦ ἀρχαίου θιασκέψας τὰ πυνθανόμενα πυέλον θεάντην εύρει, ἐνθα δὲ κείμενος ὁ νεκρός ἐν θλασσῇ.

³ Luc. de Luctu, 21: Τνδὸς οὐδὲ περιχρέει.

⁴ Wallace-Dunlop, Glass in the Old World, 24: "In the word hyalus the Greeks seem to have included not only glass but everything that was of a crystalline colour, all pellucid bodies such as ice, and even gums, as Lucian uses the same word in describing the Indians anointing their dead with balsamic gums."

⁵ 2, 18: παραπλήσιοι δὲ ἐθεάσατο καὶ τὸν Κύρου τάφον· ἦν δὲ πύργος αὐθίος δωδεκάστεγος, ἐν δὲ τῇ ἄκρᾳ στέγη ἔκειτο αὐτὸς ἐν χρυσῷ πυέλῳ, καὶ οὐδεὶς περιεκέχυτο αὐτῷ, ἀπότε τὸ τρίχωτα αὐτοῦ φαίνεσθαι καὶ αὐτὸν δὲ ὅλον σιὰ τοῦ οὐδεού.

⁶ Ps. Callisth. 2, 18: ipsius vero Cyri conditorium erat lapide visendo, cuius sive natura perpiscua, sive inscalptio adeo tenuis erat, ut nihilo prorsus quicquid interesset impediret intuentium diligentium, adeo ut propter saxi illius evidentiam capilli etiam conditi cadaveris viserentur.

such a temperature that it would utterly disfigure any corpse. If we are to believe any part of the accounts at all we must think of a transparent varnish, shellac, or lacquer. Some authors no doubt wittingly called a substance which was not glass hyalos, while others perhaps mistook a substance vitreous in appearance for real glass, or, finally, a foreign word may either have been mistaken for glass, or else it may have been used generally of several transparent, glistening substances, including glass, and the Greek authors were not aware of this fact. In any case this tradition does not deal with glass as we know it.

Although the hyalos, the burning-glass kept at the druggist's shop in the Nubes of Aristophanes, was probably of glass, a scholiast has interpreted it as crystal.¹ This shows that the scholiast, at least, thought that hyalos might designate crystal. Achilles Tatius seems to indicate rock-crystal when he describes a cup of hyalos orōrygmenē, 'glass that has been dug up.' About the cup was a vine from which hung grapes so skillfully engraved that when the cup was empty, they looked unripe but when it was full of wine, they looked red and ripe.² After finding hyalos used in

¹

Schol. on Aristoph. Nub. 766: [Τοῖσι φαρμακοπώλαι: φαρμακοπώλαι, κυρίως οἱ τὰ φάρμακα πιπράσκοντες, τά τε λυετελοῦντα καὶ τὰ θανάσιμα. πάρα τοῖς παλαιοῖς δὲ καὶ οἱ τοὺς τίμαλφεις (τούτεστι πολυτίμους) λίθους πιπράσκοντες φαρμακοπώλαι ἐλέγοντο. οὐδεὶς γάρ τῶν τολούτων λίθων, ὃς οὐκ ἔχει καίνοτέραν, δύναμιν. Junt.]

²

Ach. Tatius, 2, 3: ὑάδου μὲν τὸ πᾶν ἔργον δρωρυγμένης· κύκλῳ δ' αὐτὸν ἀμπελος περιέστεφον ἀπό τοῦ κρατήρος πεφυτευμέναι. οἱ δὲ βότρυες πάντη περικρεμάμενοι· ὅρφαξ μὲν αὐτῶν ἔκκοτος δόσον ήν κερὸς ὁ κρατήρ. ἔαν δ' ἔγχεης οὖν, κατὰ τικρὸν ὁ βότρυς ὑποπερκάγεται καὶ σταφυλὴν τὴν ὅρφακα ποιετ. Διόνυσός τ' ἔντετύπωται τῶν βοτρύων, ἵνα τὴν ἀμπελον γεωργῆ.

such a way, it does not seem strange that Pollux should list it among the things that are mined.¹

The first certain use of hyalos or any of its derivatives in the meaning of 'glass' seems to be in Aristophanes,² for hyalinos in Corinna and hyaloeides in Philolaus and Ion of Chios, although probably designating ordinary glass, cannot, because of their employment in mere comparisons, be regarded as unequivocally presupposing at that time the application of hyalos to glass rather than to crystal or some other transparent precious stone, but those who think that the burning-glass was made of crystal mention Plato³ as the first to apply hyalos to actual glass.⁴ Although its use was rather uncommon at first, in time it became so well known that hyalos alone was employed to designate a glass vessel.⁵ The chief characteristic of hyalos, 'glass,' as might be expected from its application to other substances of a vitreous appearance, was transparency. Not only was its transparency frequently mentioned or inferred,⁶ but it was used as a standard with which to

¹ Pollux, 3, 87: χρυσός, ἄργυρος, ὄρεχαλκος, σίσηρος, καττίτερος, ρόλυρος, γάλος.

² Nub. 768. Compare Ach. 74: ἐξ ςαλίνων ἐκπωμάτων.

³ Tim. 61 B.

⁴ Thes. Gr. Ling. 8, 7.

⁵ Galen, 13, 42, 290; Apocryphal Gospels (in Textes et Docum. 1, 1, 26, 31, 32); Orib. (Daremburg-Ruelle, Oeuvre de Rufus d'Ephèse, 569); Geop. 9, 19, 10.

⁶ Aristot. Probl. 11, 905 B, 6, 25, 939 A, 13; Analyt. Post. 1, 31, 88 A, 14. Hero, Definitiones, 4, 102, 16: καὶ καθ' ἔτερον δὲ τρόπον ὑποτίθεται τὰ μὲν δι' αἰθέρος καὶ ἀέρος δρώμενα κατ' εὐθείας γραμμὰς δράσθαι φέρεσθαι γὰρ πάν φῶς κατ' εὐθείας γραμμὰς. δύσα δὲ διαφαίνεται δι' ὑέλων ἢ ὑμένων ἢ ὕδατος, κατὰ κεκλαυσμένας, τὰ δὲ φαινόμενα ἐν τοῖς κατοπτρίζουσι κατὰ κνακλωμένας [γυνίας]. Id. 106, 3: ὅποια γὰρ ἢ τῶν ὄψεων πρόπτωσις, τολουτος καὶ δὲ καταφωτισμὸς ὑπὸ τοῦ ἡλίου γίνεται, καὶ τότε μὲν κατ' εὐθείας ἀκλαστούς, τότε

compare anything else which is transparent.¹ It even developed a

Σὲ κατὰ δυορένας, ὥσπερ ἐπὶ τῶν θέλων. Id. 106, 10: ἡ δὲ ἐπὶ τῶν ὑδάτων καὶ τῶν υγρέων τὰ κατὰ διάδυσιν θεωροῦσα ὅπτικὴ ἐλάττω μὲν θεωρίαν ἔχει, αἴτιο λογεῖ δὲ τὰ ὅπτα τοῖς ὑδασταῖς ὑρέσι καὶ βέλοις, ὅπιότε διασταραττόρενα φαίνεται τὰ θεωρένα καὶ σύνθετα τὰ ἀπλά καὶ τὰ ὅρθα κεκλασμένα καὶ τὰ μένοντα κινούμενα.

Idem, de Speculis, 3: In aquis autem in vitris <non> omnes refringuntur ... per vitrum enim et per aquas videmus non ipsos et ultra iacentia in palustribus enim aquis que in fundo videmus et per vitra eaque ultra iacent. Alex. Aphrod. on Arist. de Anima, 138, 28: γελοτὸν γάρ τοι τὸν μὲν λίθον τὸν διαφανῆ οὐ τὴν θαλατὴν λέγειν εἰναι τελείων, τὸ δὲ φῶς λέγειν. Ibid. 149, 26: ἡ δὲ θάλασσα καὶ τὰ διαφανῆ, οὓς τοὺς οἴκους πράτουσιν, θαλάττας ἔστιν, ὡς δῆλον ἐκ τῆς γενέσεως αὐτῶν.

Idem on Arist. Metaphysica, 588, 40: ὥσπερ εἴ τις ἐν κηρῷ πλάστας εἴδε τὸν κηρίνον καὶ τεκτὸς ἐπιθεῖς θάλατὴν οὐδὲν οὐδὲ τὸ τὸν διαφανῶν, δράτα τὸ ἐντὸς ἀντὸς κηρίνον εἶδος. Damascius, Dubitaciones et Solutiones (ed. Ruelle, 1, 183, 11): ὡς εἰ λέγοις θάλατὴν οὐτοις τῶν διαφανῶν δῆλον ὅπατόν. Philoponus on Arist. de Anima, 319, 15: ἐπειδὴν οὖν ἐν τῷ δρισμῷ τοῦ χρώματος ἐμρήσθη τοῦ διαφανοῦς, διδάσκει δημάσ, τί ποτέ ἐστι τὸ διαφανές, οὐτὶ φύσις τίς ἐστιν ἐν πλεόσιν ὅπαρχουσα, ἐν δύστῃ, ἐγ δέρι, ἐν οὐέλῳ καὶ ἐν ἐτέροις, διαπορθμευτικὴ τῶν χρωμάτων, οὐ τίς φωτὸς μὲν καὶ παρόντος δυνάμει ἐστιν αὐτὸ τοῦτο διαφανές, ἐνεργείᾳ δὲ γίνεται διαφανὲς φωτὸς παρόντος.

Ibid. 320, 26: σημεῖον δὲ τούτου, οὐτὶ εἰ θάλατὴ οὐ διαφανοῦς λίθου μία ἐπιφάνεια χρωθεῖ. Idem on Arist. Meteor. 44, 1: ἐπειτα πολλοὶ τῶν στερεμνιώτατων λίθων εἰσὶ διαφανέστατοι καὶ δι θαλασσῆς... δράτας γάρ τὰ ἐκ τούτων τριβόμενα καὶ μάλιστα τὰ ἐξ θαλασσῆς ἐκπιρούμενα τῷ θερμότητι.

Suid. 1319, 18: διαφανές ἐστι δὲ διαφανῆ οὐκ ἀπρ. μόνον καὶ θάλατὴ ἀλλὰ καὶ πολλὰ τῶν στερεῶν τωμάτων. οὐτοις φεγγύται λίθοι, κέρατα, θελος, γύψος καὶ ἐτερά. Nemesius, de Natura Hominis (Patr. Gr. 40, 645 B): οὐτοις δὲ διὰ θαλατῆς καὶ τῶν ἀλλῶν τῶν τολουτοτρόπων, δῆλον δέ, οὐτε πεφωτισμένων.

Transparency is mentioned frequently in connection with glass objects which will be spoken of later.

1

Topaz is compared to glass. Agatharchides, de Mari Erythraeo (Müller, Geog. Gr. Min. 1, 170), in Photius: ἐν δὲ ταύτῃ γίγνεται τῇ νήσῳ, φησί, καὶ τὸ καλούμενον τοπάζιον. ἐστι δέ τοῦτο λίθος διαφανόρευος, οὐάλω (γάλωβα) προσεμφερής, ἀδεταν ἔγχρυσον θεωρίαν ἀποδιδούς. In Diiodorus, 3, 39, 5: εὑρίσκεται γάρ ἐν τῇ νήσῳ ταύτη τὸ καλούμενον τοπάζιον, οὐπερ ἐστὶ λίθος διαφανόρευος ἐπιτερπής, οὐάλω παρεμφερής. Psellus, de Lapid. 25: τοπάζιον λίθος ἐστὶ διαφανής, οὐάλω παρεμφερής. The city and the streets of Heaven are compared to pure or transparent glass. Here there seems to be the idea of brightness as well as transparency. Rev. 21, 18: καὶ οὐ πάλις χρυσίον καθαρὸν ὅμοιον θάλω καθαρῷ. Id. 212: καὶ οὐ πλατεῖα τῆς πόλεως χρυσίον καθαρὸν ως θάλος εἰσαγύνης.

Andreas Caesar. (Patr. Gr. 106, 437) on Rev. 21, 21: διὰ τὴν πλατεῖαν τῆς πόλεως, διὰ μὲν τὸ πολυτελές καὶ εὔχροον, ως χρυσίον, διὰ δὲ τὸ καθαρόν, ως κρυστάλλου ἐθεάσατο, [καὶ τοις ως θαλοῖς διαυγῆ] ἀπερ ἀμφότερα ἐν ἐνὶ συνδραμένη παρ' οὐρανοῖς, ἀδύνατον.

figurative meaning with which moral qualities might be compared.¹ It is to molten glass more frequently than to merely transparent glass that the physicians compare the vitreous humor of the eye,² and humors of the body.³ Some of the other characteristics are

Of the joinings of bones, Anaphora Pilati, 2 (ed. Tischendorf, Evang. Apoc. 422): *καὶ γυναῖκα αἱρόρροσσαν ἐπὶ χρόνοις πολλοῖς, ὡς ἔξ αὐτῆς τὰς ρύσεως τοῦ αἵρατος πάσαν τὴν τῶν ὀστέων ἄρρονταν φάίνεται καὶ ὑέλου σίκην σιαυγάγειν.*
 Of bubbles in raindrops, Alex. Aphrod. Probl. 2, 39: *καθάπερ καὶ τῶν ὑαλὸν ἔστιν ἵσεται ἐπὸ τοῦ πνεύματος φυσωμένην, καὶ πᾶν ὑγρὸν ἐν τῇ ἐψήσει πνευματούμενον.*
 Of skin, Ibid. 2, 4: *τῇ σὲ λεπτότητι τοῦ δέρματος ὥσπερ διὰ ὑέλου ἐργάζεται τὸ εὐαγθὲς τοῦ χρώματος.* Rufinus (Anthol. Pal. 5, 36): *τῆς σὲ 'Ροδοκλείης υάλῳ ἵσος, ὑγρομέτωπος, οἷα καὶ ἐν υἷς πρωτογλυφὲς φόρον.*

According to Jacobs, "Vitri similitudo ad laevitatem referenda est." There is a clear, thin skin which looks almost transparent.

¹ Photius, Myriobiblon, 275 (Patr. Gr. 104, 244 A): *δέ τι, φησίν, αἱ ἴστορίαι τὴν Μαγδαληνὴν ταύτην διὰ βίου παρθένον διδάσκουσι. καὶ μαρτύριον σὲ αὐτῆς φέρεται, ἐν τῷ λέγεται διὰ τῶν ἄκρων αὐτῆς παρθενίαν καὶ καθαρότητα ὡς ὑαλὸν αὐτῶν καθαρὸν τὰς βασανιστὰς φάίνεται.*

² Galen, 3, 761: *Τὸ ὑαλοειδὲς ὑγρόν, καὶ σώμα παχύτερον καὶ λευκότερον αἵρατός ἔστι, τοσοῦτον τοῦ κρυσταλλοειδοῦς ὑγροῦ ἡ προδειπόρευον ὑγρότητε καὶ φανότητε. Τὸ γ' ὑαλοειδὲς ὑγρὸν μὲν ὥσπερ τὸς ὑαλὸς ὑπὸ θερμοῦ κεχυμένη.*

Aëtius, Ιατρικά, 7 (in the edition, Die Augenheilkunde, Hirschberg), I: *ὑγρὰ σὲ ἔστιν ἐν τῷ ὄφθαλμῷ τρία. ἔνδοθεν μὲν πάντων τὸ περιεχόμενον ἐν τῇ κοιλότητι τοῦ ἀκριβληπτροειδοῦς χλευθῶνος ὑελοειδὲς λεγόμενον. προσέοικε γάρ, καὶ τῇ χροιᾳ καὶ τῇ συστάσει, τῇ κεχυμένῃ υάλῳ. τούτου σὲ ἔξωτέρω κεῖται κατὰ τὸ πέρας τοῦ ἀκριβληπτροειδοῦς χιτῶνος τὸ κρυσταλλοειδὲς ὑγρόν, δ' καὶ δισκοειδὲς καὶ φακοειδὲς καλεῖται. προσέοικε γάρ τῇ τὴν χροιὰν κρυστάλλῳ τῷ σὲ σχύματι φανῶ ἔξωθεν σὲ περικέχυται τούτῳ τὸ ωοειδὲς ὑγρόν. προσέοικε γάρ, τῇ χρόᾳ καὶ τῇ συστάσει, τῷ ἐγ τοῖς ωοῖς ὑγρῷ τῷ λευκῷ καὶ λεπτῷ. τὸ τὴν σὺν πάντων ἔνδοθεν τὸ υελοειδὲς ὑγρὸν πρὸς τὸ τρέφειν τὸ κρυσταλλοειδὲς παρεσκεύασται.*

³ Galen, 7, 138: *Τοιοῦτον σὲ ἔστι παραπλήγιον υάλῳ κεχυμένη κατά τε τὴν χρόαν καὶ τὴν σύστασιν, δύν περ δὴ καὶ υαλώδη χυμὸν οἱ περὶ τὸν Πραξαγόραν τε καὶ φλότιμον δυομάχουσιν.*

Ibid. 8, 81: *Τὸν υαλώδη προσαγυρευόμενον ὑπὸ Πραξαγόρου χυμόν, διὰ υάλῳ κεχυμένη προσέοικεν τὴν χροιὰν καὶ τὴν σύστασιν.*

Ibid. 16, 367; 5850rib. (Bussemaker-Daremburg, 5, 550 from Galen): *ἔστι σὲ παχὺς οὖτος ὄμοιός που υάλῳ κεχυμένη τῷ πάχει.*

brightness,¹ solidity,² brittleness,³ and possibly smoothness.⁴

Even after hyalos came to be the universal name for glass, it was still occasionally applied to other substances. Possibly it stands for a diamond in a puzzling letter of the early fourth century found among the papyri of the Fayum towns. "Eudaemon to Longinus greeting. I entreat you, sir, to hasten to me and bring, if you please, the crystal (?) and we can clip the cash. If you . . . , you will be able to strain me some good Mareotic wine when you come, with the value. Good-bye."⁵ The editors think that hyalos is "here a stone implement of some kind for clipping coins, in order that the writer might get some wine with the proceeds of this (nefarious) transaction." On the other hand, Bücheler gives an entirely different interpretation. He considers that Eudaemon merely wanted Longinus to bring a glass for his wine.⁶ Instances have been given of the use of hyalos alone for a glass vessel, and later a similar use of vitrum, especially for a goblet will be noted, all of which supports the latter interpretation.

¹ Rev. 21, 18, 21. Suid. ἔνδιος· μεσημβρινός· ὄφρα μὲν οὐρένδιος ἔννέτι, θέρμετο δὲ χθών, τύφρα δ' ἔννάλοιο φαντέρος ούρανος ἕνοψ.

² Alex. Aphrod. on de Anima, 133, 18: εἰ δὲ λέγοιεν τὸ στερεὸν ἐπιπροσθεῖν στερεὰ καὶ διάλος καὶ τὸ κέρας καὶ οἱ διαφάνεις λίθος.

³ Alex. Aphrod. Probl. 41, 28, children are not hurt by a fall: τῷ λόγῳ τούτῳ καὶ σπόργος πίπτων οὐ ρήγνυται, ὑέλος [sic!] μέντοι διστρακόν, οὐτὶ τολουτον σῶμα σκληρὸν πίπτον κλαται.

⁴ Rufinus (Anthol. Pal. 5, 36).

⁵ Grenfell-Hunt-Hogarth, Fayum Towns and Their Papyri, 134: Εὐσαΐμων λογγείνω χαίρειν. παρακληθεὶς κύριε σκύλον σεαυτὸν πρὸς ἡμᾶς φέρων εἰ δόξαρ σοι τὴν διάλον καὶ δυνηθῶ με[εγ] τὸ λογάριν περικόψε, έπειτα . . . σ., καὶ καλὸν Μαρεωτικὸν δυν[ησει] μοι σειρῶσαι ἐρχόμενος επειπόντος τιμῆς ἔρρωσσο.

Translation by the editors.

⁶ F. Bücheler (Rhein. Mus. 56, 326).

In Hesychius glass seems to be called a precious stone, but the passage is probably corrupt, for glass is also called borboros, 'mud,'¹ an absurdity due to a confusion with hyollos.² Theognostus seems to have copied the corrupt text of Hesychius and in turn to have been copied by Zonaras.³

A scholiast on Aristophanes' Nubes says that Homer did not know the word hyalos but used élektros instead.⁴ This is repeated by Pseudo-Philemon.⁵ The Greeks designated both amber and a metallic compound of gold and silver by élektron.⁶ Originally perhaps élektros (masc.) stood for the metal while élektros (fem.)

¹Hesych. ὑαλος(υ)ν· λαρπρόν. πράον. [ἢ λίθος τίμιος] οὐλος. [βόρβορος].

²Ibid. οὐλός· τόπος συῶν βορβορών.

See Hesych. ed. Schmidt (1862), 4, 191, 18.

³Theognostus, Canones, 18, 28; Zonaras, Lex. 1759: οὐλος
οὐ βόρβορος, ἐνίστε σὲ καὶ τὸ λαρπρόν.

⁴Schol. V on Nub. 768: Ὀμηρος σὲ οὐκ οἶσε τὸ ὄνομα, ἀλλὰ
παρ' αὐτῷ καὶ τοῖς ἀρχαῖοις ἄλεκτρος μὲν ἔστιν, οὐλος σὲ οὐ.

⁵Lex. ed. Osann, 171.

⁶Paus. 5, 12, 7: τὸ σὲ ἄλεκτρον τοῦτο οὗ τῷ Αὔγουστῷ
πεποίηνται τὴν εἰκόνα, δύον μὲν αὐτόματον ἐν τοῦ Ἡριδανοῦ
ταῖς φάμησις εύρισκεται, σπανίζεται τὰ μάλιστα καὶ ἀνθρώπω
τίμιον πολλῶν ἔστιν ἔνεκα· τὸ σὲ ἄλλο ἄλεκτρον ἀγαμεμνύκενος ἔστιν ἀργύρω χρυσός.

Plin. N. H. 33: omni auro inest argentum vario pondere, aliubi
decuma parte, aliubi octava. . . ubicumque quinta argenti portio
est, electrum vocatur. fit et cura electrum argento addito. quod
si quintam portionem excessit, incudibus non resistit. vetusta et
electro auctoritas Homero teste, qui Menelai regiam auro, electro,
argento, ebore fulgere tradit. Compare 36, 460. In Latin electrum
was also used for the pure Latin sucinum, 'amber.' See P.-W., 3,
1, 296. Pliny, N.H. 37, 47: genera eius plura sunt. ex iis
candida odoris praestantissimi, sed nec his nec cerinis pretium.
fulvis maior auctoritas. ex iis etiamnum amplius traluentibus,
praeterquam si nimio ardore flagrent; imaginem igneam in iis esse,
non ignem, placet. summa laus Falernis a vini colore dictis,
mollis fulgore perspicuis in quibus et decocti mellis lenitas
placeat. Serv. Comm. in Verg. Aen. 8, 402: et secundum Plinium in
naturali historia tria sunt electri genera; unum ex arboribus, quod
sucinum dicitur; aliud, quod naturaliter invenitur; tertium, quod
fit de tribus partibus auri et una argenti. Blümner, Tech. u.
Term. (Bernstein), 2, 381 ff.; (Goldsilber) 4, 139, 160 ff.

and électron (neut.) stood for amber, but later these forms of the word were used indifferently.¹ It is uncertain whether Homer² meant amber or the metallic compound,³ but there is very little probability that he was speaking of glass.⁴ However, in the time of the scholiast there may have been some connection between glass and élektron which led him to hold this view.⁵ In Suidas where the burning glass is described, there is a confusion of glass and élektron.⁶ On the one hand, when élektron stands for a metal, the

¹ Lepsius, Die Metal in den Aegypt. Inschr. (Abhandl. de könige. Akad. 1871), 138 ff.

² Od. 4, 73 (71): φράγεο, Νεωτορίση, τῷ ἐρωτικοῦ σκέψεως κεχαρισμένε θυμῷ, ιχαλκοῦ τε στεροπῆν κασσώρατα ἡχηταίχρυσού τ' ἡλέκτρου τε καὶ ἀργύρου ἡδού ἐλέφαντος. Ibid. 15, 460 (459): ἡδούθ' ἀνὴρ πολύτιθρις ἐμοῦ πρὸς δώρατα πατρὸς ιχρύσεον ὅρκον ἔχων, μετὰ δ' ἡλέκτροισιν ἔερτο. Compare 18, 296.

³ Helbig, Das homer. Epos, ed. 2, 106.

⁴ P.-W. 3, 1, 295: "Rev. archeol. 16, 1859, 235 und Lagrange Recherches sur la peinture en émail dans l'antiqu., Paris 1856, Glasfluss (Smalte), Feys in der Revue de l'instruct. publ. de Belg. 1863, 461 Glas. Doch hat keine dieser Annahmen Wahrscheinlichkeit für sich, und nur darum kann es sich handeln, ob bei Homer sowie in einigen späteren Erwähnungen des ἡλεκτρού Bernstein oder die den gleichen Namen führende Goldlegierung gemeint sei." Blümner, Tech. u. Term. 4, 408: "Die mehrfach aufgestellte Behauptung, welche namentlich an Labarte und Cohausen Vertheidiger gefunden hat, dass das homerische ἡλεκτρού Smalte bedeute, ist zweifellos unhaltbar. Wir haben ἡλεκτρού in verschiedenen Bedeutungen kennen gelernt, als Bernstein sowohl, wie als Silbergold; dass es daneben noch jene dritte Bedeutung gehabt habe, dafür lässt sich nirgends ein Anhalt finden."

⁵ Ibid. l. c.: "Allerdings unterliegt es keinem Zweifel, dass electrum im Mittelalter die Bedeutung von Schmelz erhalten hat; bei Theophilus (Schedula Divers. Art. III, 53) wird es mehrfach in diesem Sinne gebraucht, und in lateinischen Schriften des zehnten und elften Jahrhunderts kommt es ebensowohl in dieser Bedeutung, wie in der des silberhaltigen Goldes vor."

⁶ Suidas: Σάλη. Σάλος. Σάλος ἐστίν ἀφ', ἡδού πῦρ ἀπτουσι. καὶ φησιν Ἀριστοφάνης. ὅποταν γράφοιτο ἡδεῖκη, ἀπωτέρω στὰς ὁδες πρὸς τὸν ἡλίον τὰ γράμματα ἐκτίνειται τῆς ἐμῆς δίκης. ἐστι δέ κατασκεύασμα Σάλου τροχοειδὲς ἡλέκτρου, εἰς τοῦτο τεχνασθέν· ὅπερ ἐλαῖω χρίσαντες καὶ ἡλίῳ θερμήναντες προσάγουσι θρυαλλίδα καὶ ἀπτουσι.

Suidas is here following very closely the scholia in RV on Aristoph. Nubes, 768, but seems to have interpolated the word ἡλεκτρον which does not appear in the scholia as they are transmitted in the MSS.

lexicons describe it as gold mixed with glass and stone.¹ A table in Sancta Sophia in Constantinople seems to have been made of this artificial product.² On the other hand, some forms of amber so closely resemble glass that they could easily be confused with it. In Hesychius logourion,³ which is probably the lynkourion⁴ mentioned elsewhere as amber, is defined as hyalos or hyelos. Perhaps the scholiast in V was thinking of an amber called hyalos. However that may be, the connecting of élektron and glass by Hesychius, Suidas, and the scholiast in V, with the additional knowledge that glass and amber have been confused in other languages,⁵ and that the term glass was in Greek occasionally

¹Cyrill (Zonaras, Lex. 1,106); Photius; Bachmann, Anecd. Gr. 1,250, 4; Suidas; Etym. Magn. 425, 25; Miller, Melanges, 147 (from Flor. Ms. 304); Zonaras, 986: ἡλεκτρον ἄλλο τύπον χρυσίον μεριγμένον οὔτως καὶ λιθία. Etym. Gud. 240,9, has μεραλαύρενον instead of μεριγμένον. Etym. Magn. adds οὔτως Ἐρυτορική.

²Suidas: ἡλεκτρον ἄλλοτυπον... λιθία οἷας ἐστὶ κατασκευῆς οὕτης ἀγίας ζοφίδις τράπεζα. Zonaras, Lex. 986: ἡλεκτρον χάλκωρα καθαρόν, οὐ ἄλλοτυπον... τράπεζα, ὁ πανεγχύρετος τοῦ θεοῦ ναός. Salmas, Plin. exercit. 761 b.C: Pro ἄλλοτυπον etiam non dubito quin apud Hesychium legendum sit, οὐαλότυπον. Sic ἄλλης λιθίας apud auctorem peripli pro οὐαλῆς λιθίας. Electrum autem οὐαλότυπον χρυσέον eleganter vocatur, quasi dicas vitreum aurum, quod auri formam habeat simul et vitri. De succino id intelligendum. Similiter et in hac voce corrigendus. Eudemus Rhetor: ἡλεκτρον οὐαλότυπον χρυσίον, μεριγμένον μετὰ οὔτους καὶ λιθούς. Perperam apud eum legitur, ἄλλοτυπον.

³Hesych: λογούριον. οὔτελος. Λάκωνες. λογούριον. οὔταλος. For a discussion of the spelling see P.-W. 3, 1, 301 ff.; M. Schmidt, Hesych. 3, 47, 12. In this same note there is a discussion of Hesych. οὔτυρον. οὔταλον, which Schmidt would take as a mistake for λίγυρον, 'amber.' Others connect it with the Latin vitrum. See Curtius, Gr. Etym., ed. 5, 579.

⁴Hesych: λυγκούριον. τὸ ἡλεκτρον. "λυγκουργόν - ἡλεκτον, cod., prius Salmasius posterius Mus. correxerunt," Schmidt. On the origin of the name see Theophrastus, de Lapid. 28; Pliny, N.H. 37,34.

⁵Boisacq, Dict. Etym. 996. Blümner, Tech. u. Term. 2, 383, 1, and P.-W. 3, 1, 297, note the similarity between glass and the German word for amber given by Pliny in N.H. 37, 42: ab Germanis appellari glaesum.

applied to other transparent substances, has led several modern scholars to believe that hyalos might also designate amber.¹

Some would go so far as to suggest the correspondence of hyalo- to sualo-² which appears in sualiternicum, the Scythian name for amber according to Pliny.³

Conclusion: Although hyalos usually meant glass, it was also applied to other transparent substances, such as crystal, glazes, precious stones, and amber, as has been shown. This probably arose through a confusion at a time when the precise nature of these different substances was as yet not recognized and then the erroneous usage was never entirely corrected. But it is also conceivable that even after glass had become better known, hyalos may have been intentionally applied to other things because of the similarity in their appearance.

¹ Sonne, Kuhns. Zeitschr. 12, 359; Curtius, Gr. Etym. ed. 5, 395. Froehner, La Verrerie, 5: "Il ne serait donc pas impossible qu'on eût employé parfois le même terme pour désigner les deux matières." Thes. Gr. Ling. 8, 127: "Non est autem succino color unus. . . aliud fulvum et perspicuum instar vitri, quod genus Gr. nuncupant $\Sigma\alpha\lambda\circ\mathbf{v}$ ".

² Prellwitz, Etym. Wörterb., ed. 2, 472, considers this as doubtful. However, Boisacq, Dict. Etym. 996: " $\Sigma\alpha\lambda\circ-$ semble répondre à l'élément sualo- 'pierre transparente ou qc. de pareil' du nom scythe, c-à-d. Nord-européen, de l'ambre sualiternicum."

³ N. H. 37, 33: Philemon fossile esse et in Scythia erui duobus locis, candidum atque cerei coloris quod vocaretur electrum, in alio fulvum quod appellaretur sualiternicum. (hyalopyrrichum in Urlichs, Vind. Plin. 2, 824, accepted by Detlefsen, ed. 1873).

3. Forms and Orthography: a. Hyalos (hyelos), the substantive.-- Hyalos is ordinarily feminine, presumably under Attic influence,¹ the masculine gender appearing very rarely.² With very few exceptions³ the accent comes upon the antepenult. The first vowel is short, but in late poetry it is occasionally treated as long, metri gratia,⁴ in some of the derivatives.

The first form of the word hyalos, which we have preserved, at least, is hyalinos, used by Corinna, as mentioned above.⁵

Hyaloeides occurs in Philolaus,⁶ while hyeloeides in Ion of Chios⁷ attests the employment of the spelling with epsilon in the fifth century, B.C. Herodotus⁸ is the first to use the substantive form

¹ Schol. Pind. Ol. 1, 10: ἐπεὶ καὶ οἱ ἈΤΤΙΚΟΙ πολλὰ τῶν ὄνομάτων ἀρσενικὰ ὄντα θηλυκῶς ἐκ φέρουσιν. Ael. Dionys. in Eustath. 1390, 50 ff.: παρὰ τῷ ἄθγναίν οὐλίος δὲ Διονύσιος παρασημειούμενος τίνα ὅπως κατὰ γένη προφέρονται, φησιν οὐτω... θηλυκῶς... καὶ οὐ οὐλός. Photios, s.v. οὐλός. Bachmann, Anecd. Gr. 1, 392; Schol. Aristoph. Nub. 768; Zonaras, Lex. 1759; Ety. Magn. 774, 3 ff.; Ps. Philemon, Lex. Technol. 248.

² Théophr. de Lapid. 49: εἰ δὲ καὶ διέλος ἐκ τῆς οὐλετίδος ὡς τινὲς φασιν Alex. Aphrod. on Arist. de Anima, 142 (ed. I. Bruns): Τοιαῦτά ἔστι τῶν διαφανῶν τά τε κάτοπτρα καὶ οἱ οὐλοί, where the editor emends οἱ to αἱ, perhaps without sufficient warrant. In Lucian, Quomodo Hist. Consor. Sit, 25, one of the mss., Vat. 87, reads τῷ οὐλῷ which, however, may be a mere slip.

³ Philostratus, Vita Ap. 3, 1: καὶ στέγει αὐτοπλῆν οὐλοῦ οὐδέν. Athanasius (Patr. Gr. 28, 789 B: ἀνατείλαντος τοῦ οὐλίου αἱ καττύες αὐτοῦ διαπερῶσι τὸν οὐλόν... ὁ οὐλός οὐ συντρίβεται. Steph. Alex. 3, 20: καὶ οὐλῶν τῷ οὐλῷ. Alex. Aphrod. Problem. 1, 41, 28: τῷ λόγῳ τούτῳ καὶ στόγγος πίπτων οὐ φύγεται, οὐλός μέντοι οὐ διστραχον, οὐ τι τοιούτον σῶμα σκληρὸν πίπτον κατακλείει. Orion (Sturz) and Etym. Gud. (Sturz). 5, 39, 63: οὐλός, ἐκ μεταφορᾶς τῆς οὐλῆς.

⁴ Thes. Graec. Ling. 8, 9; W. Schulze, Quaest. Epi. 180.

⁵ See above p. 20.

⁶ See below p. 50.

⁷ See below p. 51.

⁸ Hdt. 3, 24. There is some variation in spelling. Hyelos occurs only once in manuscript P of the fourteenth century while hyalos appears uniformly in the earlier manuscripts and also in P in another instance in this same passage.

of hyalos, although, as we have seen, he does not apply it to actual glass. Then follows its use in Aristophanes,¹ Plato², and Aristotle³. In the latter hyelos also occurs. On account of the different manuscript tradition for the separate works of Aristotle, it is impossible to tell which form Aristotle himself really used. In Theophrastus⁴ hyelos appears regularly. The two forms, hyalos⁵

¹Nub. 768.

²Tim. 61 B.

³Arist. Meteor. 4, 10, 389 A, 8: χρυσός μὲν διὸ καὶ ἄργυρος καὶ χαλκὸς καὶ καττίτερος καὶ μόλυβδος, καὶ ὑάλος· καὶ λίθοι πολλοὶ ἀνάνυροι ὑδατος· πάντα γὰρ ταῦτα τέκεται θερμῷ. ⁴“ὑέλος B rec. F corr. m. I HN corr. m. I: βέλος N. de Color. 3,794A: ἐπὶ δὲ τῶν πυκνῶν ἐπὶ πάντων ἐπιφαίνεται τὸς ἀχλός, καθάπερ ἐπὶ τοῦ ὑδατος καὶ ὑάλου (ὑέλου Χ) καὶ τοῦ ἀέρος.

Probl. 11, 905 B, 6 ff.: διὰ τοῦτο καὶ μὲν τῆς σέλου διορᾶται πυκνῆς οὐσίας... ἀλλ' ἔνια κωλύεται διὰ τὸν μικρότυπα τῶν πόρων οἷον ἡ ψελος. Ibid. 25, 939 A, 13 ff.: ἐπαλλάξτουσι γὰρ οἱ πόροι, ἀλλ' οὐκ ἐν τῷ ύάλῳ. ὁ δὲ ἀὴρ οὐκ κωλύεται διὰ τὸ μὲν εὐθυπορεῖν οὐδὲ διέρχεται.

Analyt. Post. 7, 3, 88 A, 14: οὗτοι εἰ τὸν ψελον τετρυπηκένυνται ἐφώρωμεν καὶ τὸ φῶς σινόν, δηλον ἀν τὸν καὶ διὰ τέ καίσι, τῷ δράν μὲν χωρὶς ἐφ' ἐκάστης, νοῦσοι δ' ἄμφα ὅτι ἐπὶ πασῶν οὔτως.

Stob. Ecl. 1, 52 (Diels: Doxogr. 456): Αριστοτέλης ὅρας ἡταῖς κατὰ κίνησιν τοῦ κατ' ἐγέργειαν σιαφανοῦς. Σιαφανὲς δὲ οὐ μόνον εἴρατον ἀέρα, ἀλλὰ καὶ τὸ ψελόν καὶ τίνα τῶν συνιστακένων τοθέν, οἷον ψελον καὶ κρύσταλλον καὶ τίνας τῶν λαρπρῶν λίθων.

⁴De lapid. 49; De igne. 73; Frag. 184: Ἰχθύς ιστορεῖ Θ. ὅποι ἡρίγους πεπηγότας, ἀν ἀφεθῶσιν ἐπὶ τὸν γῆν, κατάγνυσθαι καὶ συντρίβεσθαι σίκην ψέλων οἱ κεραρεῶν σωράτων.

⁵Job. 28, 17; Agatharchides (Müller, Geog. Gr. Min. 1, 170, 6 ff.; 23 ff.). Strabo 3, 1, 5: διὰ δὲ τούτων ὡς τὸν αὐλῶν κλωρέννην. G. Kramer, 1, 211, “ὑάλων proposit Is. Voss. (ad. Mel. I, 18). Müller-Dübner in their Latin translation suggest vitris, “quibus tanquam fistulis [vitris?] infractos radios visus diffundi”. Ibid. 17, 2, 3; Antiphilos (Anth. Pal. 6, 250 or Suidas, s.v. ράρσος); Anon. Lond. Iatrica (H. Diels, Suppl. Aristot. 3a, col. 39, 18; Philo, Leg. ad Gaium, 45 (some of the manuscripts give ψέλος); Peripl. Maris Erythr. 49, 56; Rev. 21, 18, 21; Ael. Dionys. in Eusth. 1390, 53; Galen. 3, 760; 5, 623; 7, 138, 348; 8, 81; 11, 411, 749; 12, 185, 206; 13, 42, 663; 16, 367; Paus. 2, 27; 8, 18; Iren. (Patr. Gr. 5, 1388 A; 7, 440); Luc. Ver. Narrat. ex ὑάλου. Idem, de Luctu, 21; Quomodo Hist. Conscr. 25; Alex. Aphrod. on Arist. de Anima, 133, 18; 138, 28; 149, 28. Idem, Problem. 1, 61; 2, 39; Pollux, 3, 87; 6, 14 (in mss. C.V); P. Fay. 134, 4; Caesar Dial. 1, 68 (Patr. Gr. 38, 936); Orib. 2, 711, 15, 1; 9, 550, 5 (from Galen) Orion: ψέλην. ψέλος. Hesych. λογοεργον. ψέλος. σάλην. ψέλος. ψέλην. ψέλος. Aen. Gaz. 552, 71; Damascius, Dub. et Solut. 1, 183, 11; Ach. Tat. 2, 3; Rufinus (Anth. Pal. 5, 36; 48; Andreas

and hyelos,¹ then continue side by side, and the same is true of

Caesar (Patr. Gr. 106, 433, 437); David Armen. Proleg. et in Porphyr. Isogog. 20, 11; Schol. on Plato's Alcibiades, 132 E; Olympiodorus on Plato's Alcibiades 2, 223, ὑαλοκέρας is an error for ὕαλος κέρας. See Comm. by Creuzer, ncte 53; Thes. Gr. Ling. 8, 7. Paul. Aeg. 84, 2; 117^v, 42; Daremberg-Ruelle, Oeuvres de Rufus d' Ephèse, 444, 12; R. Briau, Chirurgie, 142; Theognostus, Canon. 18, 29; Photius, Bibl. 275 (Patr. Gr. 104, 244 A); Schol. on Clem. Alex. Paedog. 180, 28. For the dialectic form ὕαλοι (gen.) see Suid. under έρσιος and οὐράκος. Psellus, Carm. de Re Med. 596; Zonaras, Lex. 1665, 1759; Nicephorus Blemm. Epitome Log. (Patr. Gr. 142, 697, 18 C; Lyhistrus and Rhodamne, Phlorius and Platziaphlora (Konstantinides, Μεγαλέξικον under ὕαλοι—.

¹ Hedylos in Athen. 11, 486 B or Anthol. Gr. Append. 1, no. 115; Hero, Pneumat. 2, 4; Definitio[n]es, 4, 102, 16; 106, 3, 10. In the latter ὕαλοις C. Diod. 2, 15, 1, 2, 4. Joseph Bell. Ind. 2, 10, 2: "Ὕελον] PAML² ὕαλον (a ex corr. V) L'VR ὕαλλον C. Plut. Quaest. Conv. 3, 19, 3; Galen. 13, 290; 16, 585; 19, 695; Mesomedes (Anth. Pal. 16, 323); Luc. Amores, 26; Alex. Aphrod. on Arist. de Anima, 142, 28; Met. 588, 40; Idem, Pr[oblem]. 1, 119, 120; 2, 4; Clem. Alex. Paedog. 2, 3, 35; 12, 118; Philostratus, Vita Ap. 3, 1; Epist. 242, 21; P. Holm. 1. 5; Ps. Callisthenes, 2, 18, 38; Athan. (Patr. Gr. 28, 789 B); Apsyrtus (Hippiatr. 2, 82); Orib. 5, 66, 1; Daremberg-Ruelle, Oeuvres de Rufus d' Ephèse, 569; Titus Bostrensis (Patr. Gr. 18, 1193 C); Theodoreetus (Patr. Gr. 83, 617 A); Steph. Alex. De Magna et Sacra Arte, 3; Hesych. s.v. οὐελος. ὕαλος. ιογούριον. οὐελος. λάκωνες. Orion: θελός [sic]; Anaphora Pilati 3 (C. Tischendorf, Evang. Apoc. 422); Philoponus on Arist. de Anima. 2, 6, 7; Meteor. A, 3, 5; G. Hirschberg, Die Augenheilkunde des Aetius von Amida 1, 25; Alex. Trall. (Daremberg-Ruelle, Oeuvres de Rufus d' Ephèse, 95); Excerpta ex commentar. Alexandri et Olympiodori (Ideler, 29). Photius: ὑλεκτρον ἄλλαστυπον χρυσίον τελεγρένον εέλω και λ.θ.ι.α.

The spelling must be due to the copyist for Photius says elsewhere that hyalos and not hyelos should be used. Photius Patr. Constant (Patr. Gr. 101, 277 A); Meletius (Patr. Gr. 64, 1168 B ff); Bachmann, Anecd. Gr. 1, 250, 4; Leo. Philos. Conspectus. Medic. 3, 1, 129; Suid. s.v. θελόνες and ὑλεκτρον; Geopon. 5, 7, 2; 9, 19, 10; Abitan. de Urinis, 296, 20; Psellus, de Lapid. 1, 25; Etym. Gud. 76, 240; Schol. on Aristoph. Nub. 768; Etym. Magn. s.v. ἄλαραστρον and ὑλεκτρον; Zonaras, Lex. s.v. θελέκτονες; Eustratius on Aristot. Analy. Post. 151, 31 ff. (ὕαλος et ὑάλον in ms. e); Demetrius, Hieracosoph. 26, 271, 281, 283; Joan. Actuarius, de Urinis. II, 32, 21; 33, 12; Nemes, de Natura Hominis (Patr. Gr. 40, 645 B)).

the compounds and derivatives. Herodian¹ in his work on orthography puts hyalos first as the preferred form, which is what would be inferred, at least, from its more frequent occurrence up to this time, and because it seems to have been the older form. Phrynicus² and the later grammarians³ insist that the spelling with alpha is the only correct one, while a certain Polybius, of whom practically

¹ Herod. Tech. Reliquiae (ed. A. Lenz), 2, 595, 15: ὕαλος - ὕελος.

² I. De Borries, Phryn. Praepar. Soph. 118: ὑάλινα καὶ ὕαλος. Σίὰ τοῦ ἄ, οὐ Σίὰ τοῦ ἔ. C. Lobeck, Phryn. 309: ψίεθος, μιερός, ὕελος, ἀρματάνουσιν οἱ Σίὰ τοῦ ἔ λέγοντες, ἀσώκημον γάρ. καὶ Κορίννα τὸν θάλινον πατέα θήσεις. ἴο πύελος Σίὰ τοῦ ἔ, καὶ μυελὸς ρητέον.

"Primum articulum Edd. Pr. V et Phav. omittunt. . . Secundum articulum ed. Pr. hoc modo scriptum exhibet: πύελος, μυελός, ὕελος ρητέον. ἀρματάνουσι γάρ οἱ ψίης τοῦ ἔ λέγοντες, ἀλλὰ Σίὰ τοῦ ἄ. In oculos incurrit, haec non ab eodem Phrynicho scribi potuisse. ὕαλος non ὕελος dicendum esse, uno ore tradunt Phrynicus App. p. 68. Dionysius Atticista, Photius, alii. v. Sallier p. 373. Neque Theophrasti auctoritas, quam ille praetexit, tanta videri debet, ut grammaticorum sententiae, Aristophanis et Platonis testamentio communitae, idcirco abrogemus." W. Rutherford, The New Phryn. 281: ψίεθος... θήσεις. "This article is not found in any of the manuscripts in the editions of Callierges or Vascosan, or in Phavorinus; but the first Laurentian manuscript and the first editor include ὕελος in the next article. Much of this part of the book is undeniably spurious."

3Photius: ὕαλος. Σίὰ τοῦ ἄ · οὐχὶ ὕελος · καὶ θηλυκῶς οὐ ὕαλος · καὶ ὑάλινον · Αριστοφάνης Ἀχαρρεύσιν · ἐξ ὑαλίνων ποτηρίων καὶ χρυσίων · πάντα σὲ τὰ τοιαῦτα Σίὰ τοῦ ἄ λέγοντα. Bachmann, Anecd. Gr. I, 392 ff.: ὕαλος · Σίὰ τοῦ ἄ · οὐχὶ ὕελος · καὶ θηλυκῶς οὐ ὕαλος · καὶ ὑάλινον Αριστοφάνης Ἀχαρρεύσιν · ἐξ ὑαλίνων ποτηρίων καὶ χρυσίων. Bekker, Anecd. Gr. I, 68, 22: ὑάλινα καὶ ὕαλος · Σίὰ τοῦ ἄ , οὐ Σίὰ τοῦ ἔ . Schol. on Aristoph. Nub.

768 (Dübner 116): ὅτι σὲ ὕαλος θηλυκῶς, καὶ Σίὰ τοῦ ἄ . Zonaras, Lex. 1759: καὶ τὸν ὕαλον θηλυκῶς ἐν τῷ ἀλφα λεκτέον, οὐχὶ ἐν τῷ ἔ . Etym. Magn. 774, 3 ff.: ὕαλος · Σίὰ τοῦ ἄ , οὐχ ὕελος καὶ θηλυκῶς, οὐ ὕαλος. Miller, Mélanges de Lit. Grec. Etym Mag. (Flor. Ms. 304) 290: ὕαλος, 774, 4: καὶ ὑάλινον Αριστοφάνης ἐν Αχαρρεύσιν (v. 74 ubi ἐκ πωράτων καὶ χρυσίων) · ἐξ ὑαλίνων ποτηρίων καὶ χρυσίνων. πάντα σὲ Σίὰ τοῦ ἄ λέγεται.

Ps. Philemon, Lex. 171 (A forgery probably written by J. Diassarinus according to K. Krumbacher, Gesch. d. byzant. Lit. ed. 2): ὕαλος παρ' Αττικοῖς, οὐ ὕελος · καὶ ὕαλον, διαφανές · Αριστοφάνης · τὸν ὕαλον λέγεις. ὅπερ κατασκεύασθαι ἔσθιον ὕαλον τροχοῖσι δέ ταχὺ, οὐδὲ χειρόντες θηλιούς, καὶ χρίοντες αὐτό, καὶ θεραπεύοντες, προσάγουσιν θρυαλλίδα · καὶ οὕτως ἐπτουσιν. ὅτι σὲ ὕαλος θηλυκῶς καὶ διὰ τοῦ ἄ , φανερὸν παρ' Αττικοῖς. Ομηρος σὲ τὸ ὄνομα οὐκ εἶπεν, ἀλλὰ παρ' αὐτῷ καὶ τοῖς ἀρχαῖοις ἑλεκτρός ἔστιν, ὕελος σὲ οὐ. Note 248, "Similia Phavorinus h.v.p. 1789.1."

nothing is known, even lists hyelos as a barbarism,¹ which is surely going too far. The grammarians no doubt merely mean that hyalos is the Attic form and hyelos the Hellenistic, as, indeed, it is once expressed by Moeris² and Thomas Magister.³ This is only partly true, for although hyalos is Attic, it is also Boeotian⁴ and Ionic.⁵ It is, therefore, probably just the older form. There are a few other words which have similar alternate forms, the origin of the second one of which is often unknown.⁶ It has been suggested that hyelos is produced by a weakening of the alpha,⁷ or that it is an Ionic form⁸ admitted by late Atticists.⁹ Hyalos also sur-

¹ Polyb. de Barbarismo et Soloecismo (Nauck, Lex. Vindob. 284): Περὶ δὲ ἑναλλαγὴν γίνεται βαρβαρισμὸς περὶ τὰς προσωδίας, καὶ ἔταν ἔτερα ἄντοι ἔτερων λαμβάνονται γράμματα σοῦ εἰς τις λέγοι φέληται τὸν φίλην καὶ ὑστεροῦνται λέγοι φίλην καὶ δέλον τὴν σακτήν. The ms. here (see Boissonade, Anecd. Gr. 3, 230) gives φίέ φιλην καὶ δέλον τὴν σακτήν. All that can be said of the date of Polybius is that his work appeared in a manuscript of 1496. See Boissonade, 229.

² Moeris, Attic. Lex. 275: ὕαλος, ἐν τῷ ἀ. Ἀττικῶς. ἐν τῷ ἔτε, Ἑλληνικῶς. Sallier on Moeris, 275: "Ita Lucianus, qui ut et Theophrastus, διελος. l. p.1004, scribere non dubitavit. τὸ δὲ ἄλλο σῶμα, inquit, μῆνς ἀκαρδῆται τρεχός καὶ τὰς ὑποφυομένους ἡλεκτρους φασίν δὲ Σεισυνίας μέλους διαφεγγέστρους ἀπαστράπτει. Quod si ὕαλος etiam in eiusdem scriptis occurrit, ex eo illud tantum sequitur, nomen διελος et δέλος nullo discrimine ab Atticis usurpatum." Thes. Gr. Ling. 8,9.

³ Thom. Mag. 365, 1 ff.: ὕαλος Ἀττικοί. Ἀριστοφάρνης ἐν τρεφέταις τὸν δέλον λέγεις. δέλος δὲ ἄπλωτος Ἑλλήνες. See G. Meyer, Gr. Gram. ed. 3, 159; F. Blass, Gram. d. N. Test. 21.

⁴ See Corinna in Phryn. 309.

⁵ See Hdt. 3, 24.

⁶ Brugmann, Grundriss, 2, 174; Schweizer, Gram. der pergamen. Inschr. 36.

⁷ W. Schmid, Der Atticismus, 4, 683.

⁸ Smyth, The Greek Dialects, 140: "Forms in -ελος in the κοινή were once held to be Ionic, perhaps, because of Hom. πύελος πυελός, later πύαλος πυαλός. A. Thumb, D. Gr. Sprache im Zeitalter des Hellenismus, ed. 2, 75; Blass-Debrunner, Gram. d. N. Test. ed. 4, 29

⁹ W. Schmid, op. cit. 4, 580: "Vulgarismus ... welche aber möglicherweise als Ionismen passierten."

vived in popular speech along with hyelos, as is shown by its use in literature which made no pretense to Atticism, such as the New Testament,¹ its appearance in papyri,² and its survival in modern Greek.³

b. Hyalos (hyelos) the adjective.-- Hyalos⁴ (hyelos)⁵ sometimes occurs as an adjective of three terminations. The Etymologicum Magnum gives hyalinos as preferable to hyalos,⁶ and this statement is, of course, correct if one judges by standards of frequency of occurrence. It has been suggested that hyalos here may be an error for hyalous,⁷ but, despite the fact that other lexica in much the same connection speak of hyalous, there is no doubt that hyalos also was used as an adjective, and such a correc-

¹ Kühner-Blass, Gr. Gram. 1, ed. 3, 117; E. Schweizer, Gram. der pergamen. Inschr. 36; A. Thumb D. Gr. Sprache im Zeitalter. des Hellenismus, ed. 2, 18, 76.

² See note 5, page 34.

³ S. Koumanoudes, Synag. Neon Lex. 2, 1021 ff., 1030; A. Kyriakides, Mod. Gr.-Eng. Dict. ed. 2, 784 ff., 787. On the development of Yali see A. Jannaris, An Hist. Gr. Gram. 151; G. Chatzidakis, Gloss. Melet, 1, 222; G. Cousin, Etudes de Géog. anc. 254.

⁴ Lucian, Quomodo Hist. Conscr. sit, 25, (where, according to Sommerbrodt, the following variants occur, "Σάλα Marc. 434, Vatic. 90. Σάλα Harl. Σάλλα Vatic. 87", which, although in correct readings for Lucian, do yet when combined with other evidence attest the existence of these as possible forms. P. Ox. 13, 10, 1294, 6: Σάλαι λάγυνοι Σ' Σγειαί.

⁵ Galen, 14, 409: ἐν Σέλιψ ἀγγείῳ Ps. Callisthenes, 2, 38, 7: ἐν τῷ Σέλιψ πίθῳ. Paul. Aeg. 35, 10: ἐν Σέλιψ ἀγγείῳ.

⁶ Etym. Magn. 774, 3: καὶ Σάλινοι, ἀντὶ τοῦ Σάλον. Cf. Miller, Mélanges, 290: ὅθεν καὶ Σάλινα ἀντὶ τοῦ Σάλα (Σάλα?).

⁷ "Pro Σάλον sententia requirit potius Σάλον, vitreum," wrote Sylberg, unaware apparently of this employment of Σάλος - η - ον as an adjective.

tion here would be nothing less than the destruction of evidence. Finally it should be noted that among the Romans hyalos was also glossed by vitreus.¹ In every case the significance is 'made of glass,' but Hesychius² also gives the derived meaning 'bright.'

c. Hyallos (hyellos).-- In late Greek a spelling with with double l, i.e., hyallos and hyellos sometimes appears.³ It is impossible to say at just what time this spelling begins, but the manuscripts in which these forms occur (in so far as I could find any indication of their age) range from the eleventh to the four-

¹ Corp. Gloss. Lat. vitrum vitreus ὑαλος; vitreum γέλος.

² Hesych. ὑαλόν· λαρπρόν. Schmidt, "In cod. ὑαλόν scriptam malui in ὑαλούν mutare, quam cum Thes. in ὑαλόν." See Thes. Gr. Ling. 8, 7, s.v. ὑαλός. There seems to me no need for changing the manuscript reading.

³ Hdt. 3, 24: ἐξ ἡλίου ν' (S.XIV); Aristot. Meteor. 4, 10, 389 A, 8: "ὑέλλος Brec. F corr. m.l." (B. S. XII, F.S.XIV); Strabo, 17, 2, 3: ὑαλλον F (S, XIV); Joseph. Bell. Iud. 2, 10, 2: ὑαλλον C (S.XI); Herodian, Epim. 138: ὑέλλος· ὑέλλοψες. Note ὑέλλος "quod sequitur sic per duplex λ scriptum est in Lexico π. πνευμ. p.236," Boissonade. Luc. Ver. Hist. 2, 11: ὑέλλινοι Vatic. 87 (Sommerbrodt), N (Nils Nilén); Id. Quomodo Hist. Conscr. 25, ὑαλλα, ὑάλλοι Vatic. 87. Alex. Aphrod. on Aristot. Met. 588, 40: ὑέλλον AL(S. XIII); Ps. Callisthenes (ed. Meus) 2, 38: ὑέλλινος (quoted from Crönert, Memoria Gr. Herculaneensis, 75, 7); Hesych. s.v. ἀέτυρον· γάλον Ald. (1514) γαλλον. Ibid. ἐνβέρος· ὑέλλοειδῆς. [ἐνβερνοειδῆς· ὑέλλογένης(sic)C]; Ibid. κρόσταλλος· ἐδος ὑέλλου. Schmidt, "Dialectus est Cypria. ὑέλλον cod., em. Palmer." Alex. Aphrod. Probl. 1 132 (ed. Ideler, 1, 45): σιὰ τὶ τὰ ὑέλινα κάτοπτρα λάρπουσιν ἄγαν, ὅ τι ἔνδοθεν αὐτῶν χρίουσι κασσιτέρῳ πέφευκε σ' αὐτοῦ ἡ φύσις διαυγῆς καὶ τῷ ὑέλλῳ ἀναμιγνυμένη λάρπρᾳ οὐσῃ πλέον διαυγάζεται, καὶ τὰς ἴσιας ἄκτινας σιὰ τῶν πόρων τῆς ὑέλλου παραπέμποντα διπλασιάζει τὸ ἐπὶ πολλῆς καὶ ἔκτὸς τοῦ σώματος τῆς ὑέλλου· καὶ οὕτως γίνεται σφόδρα λάρπουσα.

Olympiod. on Arist. Meteor. IV (ed. Ideler, 2, 228): Ald. ὑέλλεψεις Ideler quotes Hesych. ὑέλλεψεις· ὑελοτέχναι, but there is no indication in the Schmidt edition of a double l in this passage. J. Nicole, Le livre du préfet, 71 (Cod. Jul. Ascal.), 19. Title - περὶ ὑελλουργῶν καὶ τῶν ὄμοιών τ. I. I: ὑελλουργούς Gen. ms. 23 Σ (S.XIV). Suid. ὑλεκρόν· ἀλλότυπον χρυσίον, τεριγρένον ὑέλιψ καὶ λιθία. Ms. E ὑέλλιψ. Zonaras. 1043: ὑέλλινον. 1665: ὑέλλος Α. Georg Lacapen de Syntaxi, 114: ώσπερ γάρ ὁ ὑλιος σιὰ μέσου ὑέλλου, ἡ ὑδατος τὰς ἄκτινας ἐκπέμπει τὸ φῶς (Quoted from Du Cange).

teenth century, and the double l is used in some of the Aldine editions also (see preceding note), so that this must have been a vulgar spelling which had grown pretty common by the fifteenth century, but is not attested by papyri or inscriptions and hence is probably Byzantine in origin.

d. Hyalē.— Like a few other nouns (e.g., chonos-nē, tylos-lē, etc.),¹ the word for glass, according to the lexicographers,² was also heteroclitic, i.e., hyalos and hyale. The latter form, however, occurs very seldom outside of the lexica. In two manuscripts of Suidas, where he is quoting Antiphilus, hyalēs is used instead of hyalou.³ An interpolation in the text of Dioscorides⁴ contains the word hyalē, but the accent falls upon the

¹Lobeck, Pathol. Proleg. 7 ff.

²Orion (Sturz); Photius; Bachmann: Anecd. Gr. I, 393; Suidas; Etym. Gud. (Sturz, 538): ὑάλη· υάλος. Hesychius also defines hyalē as hyalos but he gives it the further meaning of a 'worm.' ὑάλη· υάλος. θόρβος· τκώλης. Similarly, ὑάλεται· τκώληκιε. Elsewhere εύλη is defined as a worm. εύλάγχει· καπρᾶ· τκώληκιε. | εύλαε· οἱ ἐν τοῖς τραύμασι γνωρεοι τκώληκες. | εύλες· τκώληκας. | εύλέων· τκώληκων. From this it has been conjectured that ὑάλη and ὑάλεται are probably dialectic forms for εύλη and εύλάγχει. Thes. Gr. Ling. 8, 7, s.v. ὑάληται. "Fortasse alicubi ὑάλεται pro εύλάγχει et ὑάλη pro εύλη corrupte scriptum reperit. Supra: εύλάγχει· τκώληκιε Ruhnk." See Curtius, Gr. Etym. ed. 5, 564: "While the stem εύλη with pre-fixed ε' stands for ε'-φλη, in ὑάλη the initial F survives in the form of u... ὑάλεται, however, is no denominative like τκώληκιεν· εύλάγχειν... but must be regarded as a primitive verb in the sense of 'swarms'."

³Suidas, s.v. νάρδος... νάρδον, ὑπὸ γλαυκῆς κλειομένην ὑάλου (ὑάλης reading of mss. B E).

⁴Interpolator of Dioscorides, I, Parabil. 170 (ed. of Venice 1518): φαλῶν αὐτὸς εἰς ὑάλην, καὶ κρέμασσον εἰς ἄλιον ἀνέρας οἱ'. These interpolations date from the period between Galen and Oribasius (Wellmann in P.-W. 5, 1141, 9 ff.).

last syllable, a thing which happens very rarely with hyalos (hyelos). It is possible that the hyalē (oxytone) of the Interpolator is not just the same as the hyalē (paroxytone), which the lexica define as 'glass,' but some special kind of a glass vessel. Yet those who define it as a 'vial'¹ or a 'glass vessel'² do not explain its accent, but consider it the same as the hyalē with the ordinary accent, i.e., paroxytone. In that case there is no reason to give it any further definition than that of the lexica, simply 'glass.' The Greeks used hyalos (hyelos) for a glass vessel or something made of glass. The physicians³ especially speak of putting a medicine 'in' or 'into a glass' without any specification as to the nature of the vessel. The use of hyalē (oxytone) by the Interpolator of Dioscorides seems very similar. Of course this may have been a vial, and so might the nard-glass of Antiphilus, but since the word vial is not derived from hyalē and there is nothing in the context to throw light upon the shape of the vessel, except that it is likely to have been of small or moderate size, any opinion is nothing more than a guess. Then, in spite of the accent which occurs so seldom on hyalos, it seems probable that hyalē (oxytone) is the same as the hyalē (paroxytone) defined as hyalos.

1

DuCange, Gloss. Med. et Inf. Gr. 2, ὑάλη: "vas vitreum colli angustioris, nostris inde Fiole," quoting the interpolator of Dioscorides, 1, Parabil. 170. Since fiole is derived from L. phiala, Gr. φιάλη (see Skeat, An Etym. Dict. of the Eng. Lang. 690), there is no etymological evidence for this interpretation.

2

Thes. Gr. Ling. 8, 9. Perpl. Maris Er... λιθίας ναλῆς πλείονα γένη. "Interpr. Omnis generis vasa vitrea," but this is clearly the adjective and not a noun, and hence does not belong here.

3

Galen. 13, 42, 290; Orib. (Daremburg-Ruelle, Oeuvres de Rufus d'Éphèse, 569).

in the lexicons and when used alone for a glass object, it is to be interpreted according to the context.

e. Proper Nouns.-- Among the nymphs of Diana there was one by the name of Hyalē,¹ the 'glassy-bright,' a designation which probably suggests the bright, clear water of mountain springs.²

In a list of Athenian Ephebi, as given by Boeckh,³ the name Loukios Hyalos occurs. Keil⁴ thought this was very doubtful and proposed Hyllos,⁵ but there is no doubt of the readings of the inscription,⁶ and, in view of Hyalē (above), the name seems to be a possible one.

f. Hyalas.-- The form hyalas occurs in a Greek papyrus in the British Museum.⁷ Kenyon thinks the termination is irregular and lists it in the index under hyalos. It is very unlikely, however, that this has anything to do with glass, but by

¹Ovid, Metam. 3, 171.

²Of course Hyelē, the old name for Elea (Strabo, 6, 1, 1; Herod. Tech. Reliquiae, 1, 284, 23; Diog. Laert. 9, 28), a town in Lucania, has nothing to do with hyalos. It represents the Latin Velia, the upsilon standing for the Latin V or W sound (W. Schulze in Kuhns. Zeitschr. 23, 396; P. Kretschmer in Wiener Eranos, 1909, 120).

³CIG I 286: ΛΟΥΚΙΟΣ ΥΑΛΟΣ = IG III 1161, 21.

⁴Keil, Spec. Onom. Gr. 77.

⁵Hyelos (Pape-Benseler s.v. "Υελος") occurs as an error for Euryale, the mother of Orion. See Schneider, Nicandrea-Theriaca et Alexipharmacata, 5, 26: "Ηερίοςος δέ φησιν αὐτὸν ἐξ Εὐρυάλης τῆς Μίνωος δυγατρὸς εἶναι καὶ Ποσειδῶνος. Note on Ηερίοςος: "cf. schol. Arat. phaen. 322 Eratosth. catast. 32 Εὐρυάλης Eratosthenes l.c. Apollod. 1, 4, 3 Εὐρύλου ΚΑ".

⁶It is in the Louvre, no. 140 in Froehner's Inscr. Grecques du Musée du Louvre.

⁷P. Lond. 2, 402, 13: ποτηρίον υαλας (sic).

folk etymology it probably arises from gyalas,¹ a special kind of cup mentioned by Athenaens.²

4. Simple Derivatives: (a) Hoialas.-- A curious form hoiala occurs among the Christian sepulcral inscriptions. It has been plausibly interpreted as a vulgar variant for hyala, that is, the genitive singular of *hyalas, to indicate a worker in glass.³

(b) [Hyaleis].-- See below note 4.

(c) Hyaleos (hyeleos).-- Neither hyaleos⁴ nor the contracted form, hyalous⁵ (hyelcus),⁶ occurs before the time of Strabo. The uncontracted form is rare, but the use of hyalous is fairly

¹ U. Wilcken (Archiv für Papyrusf. 1, 135); Herwerden, Lex. Gr. Supp. et Dialect. s.v. γάλας; Mayser, Gram. d. gr. Pap. 164.

² Athen. 1, 31: **ΓΥΑΛΑΣ.** Φιλητας ἐν Ἀτάκτοις Μεγαρέας οὗτω φυσί καλεται τὰ ποτήρια, γυάλας. Παρθένιος δ' τοῦ Διονυσίου ἐνα' περὶ τῶν παρὰ τοῖς ἱστορικοῖς λέξεων ζητουμένων φυσί. 'γυάλας ποτηρίου εἴδος, ὡς Μαρσύας γράφει δ' ιερεὺς τοῦ Ἡρακλέους οὗτως. 'Ο ταν εἰσίη δ' βασιλεὺς εἰς τὰν πόλιν, ὑπαντάν οἴνου πλήρη γυάλαν ἔχοντά τινα, τὸν δὲ λαβόντα σπένδειν'.'

³ Bayet (Bull. de Corr Hellén. 2, 166, n. 62); I G III 3436: Κυρηντείηριον Εὐφραστείου οἰαλά κε Γενναδίας.

⁴ Strato (Anth. Pal. 12, 249); Maecius (Anth. Pal. 6, 33), of uncertain date, as well as the following. C. Wessely, Corp. Papyr. Hermopolitan. (Stud. zur Pal. u. Papyruskunde, 5, 9, 6): καὶ σκεύη ποικίλα ψέλεα. Hesych. ψάλε(ο)ν. "ad h. 1. ψαλέρ non erat ψαλόερ corrigendum cum Thes., sed ψάλεον (hoc accentu, Lob. Path. Prol. 101) quod ordo poscit," Schmidt.

⁵ Strabo, 4, 5, 3; Democrat. in Galen, 14, 99, 5; Peripl. Maris Erythr. 6, 7, 17, 39; Dio Cassius, 57, 21, 7; Luc. Quomodo Hist. Conscr. sit. 25: εὔλινα (εὔλα οὐγεύλα Harl.) Sommerbrodt) Hippolytus, Elenchos, 2, 235, 2; Hesych. s.v. τριόπιος and εὔλούν.

⁶ P. Lond. 2, 191; Soranus (Idelex, 1, 248); Galen, 13, 41; 54; 97; 98; 1056; 1057; Hippolochus in Athen. 4, 129 D; Clemens Alex. Paedog. 2, 4, 39; P. Fay. 104, 1, 2; Pollux, 6, 14: ψάλου CV. ψελούντα; Orib. 1, 384: 2, 60 (from Antyllus), 62, 64; 4, 630; Paul. Aeg. 26, 27; 121, 12; 132, 1; Geop. 9, 19, 9.

common, although not so much so as hyalinos, for which the grammarians¹ express a preference above other adjectives of a similar meaning. Hyaleos usually has the significance 'of glass,' 'made of glass,' but it also sometimes means 'bright,' 'smooth,' 'transparent,' or 'like glass.'² It is used in describing the cheek of a boy,³ and eyes,⁴

(d) [Hyalēs].-- See below note 3, page 45.

(e) [Hyalieus].-- See below note 2, page 45.

(f) Hyalizō (hyelizō).-- The present participle of hyalizein, 'to be like glass,' is employed to describe resin,⁵ gums,⁶ the slag of lead,⁷ and gems.⁸ Hesychius uses it in defining hyale(o)n.⁹ The resin is said to be 'like glass in color.' This

¹ Photius (Porson): ὔαλινα · ἀρτὶ τοῦ σαλᾶ. "Accent om. m. pr. ὔαλα voluit corrector, ni fallor." Zonar. 1759: ὔαλινον, οὐχὶ σαλουν. See note 7, page 38.

² Hesych. ὔαλε(ο)ν · λαρπρόν, ὔαλικον. See Thes. s.v. ὔαλος. Ibid. ὔαλο(ο)ν · λαρπρόν · πρᾶον. "In cod. ὔαλον scriptam, malui in ὔαλον mutare, quam cum Thes. in ὔαλον," Schmidt. πρᾶον seems to be misplaced, as it makes no sense here. I should retain the manuscript reading, see above, page 38.

³ Strato (Anth. Pal. 12, 249): ρουποίητε μέλισσα, πόθεν τέλιτού τὸν ιδοῦντει παῖδος ἐφ' ὑαλένην δψιν | ὑπερπέτασα. Paton translates this "smooth as glass." Since transparency is the chief characteristic of glass, when a complexion is said to be like glass, it also suggests a fair, clear complexion.

⁴ Hesych. s.v. τριοπής · τριόψυθαλμός. Ἐνιοις κῶνον δρυολον ἀκρίδι. Καὶ πτερί τριχήλιον τρετη ἔχον δψθαλμούς σαλούς. "Denique ὔαλον cod., ὔαλον Salmas., ὔαλινον Sopinus em. Lob. Phrynic. 309."

⁵ Dioscorides, 1, 91: de Terebintho: ἡ δὲ καὶ σιαφέρει σιαυγεστέρα οὔστα, λευκή, σαλίζουσα τῷ χρώματι καὶ κιανίζουσα, εὐώδης, τερρίνθου πνέουσα.

⁶ Ibid. 1, 133, de Acacia: Τὸ δὲ κόρμι τῆς ἀκάνθης σιαφέρει τὸ σκωληκοειδές, δελίχον, σιαυγές, ἄγιον, εἴτα τὸ λευκόν. Compare Orib. 5, 72, 10.

⁷ Dioscorides, 5, 97: de Scoria Plumbi: σκωρία μόλυβδου ἀρίστη ἐστιν ἡ ψιρυνθιόφανής, πυκνὰ καὶ δύσθραυστος, μηδὲν ἔχουσα μόλυβδῶν, μηδινοειδές τῷ χρώματι καὶ σελίζουσα.

⁸ Psellus, de Lap. 1, 2: οὐδὲν δακρας χροιὰν μὲν οὗτος ἔχει σελίγουσαν καὶ στιλπνήν.

⁹ Hesych. s.v. ὔαλε(ο)ν. See above note 2.

raises the question what 'glass-colored' means.¹ Resin is a clear yellowish substance. The only characteristic which glass and resin have in common is transparency, which although not technically a color, seems to be the meaning of 'like glass in color' in this instance, at least.

(g) [Hyalîēs] -- Hyalîēs occurs in Hesychius² in a corrupt passage, which is copied by later lexicographers.³ Since hyaneoos⁴ is defined exactly as hyaliēs, doubtless the **Λ** of the latter is a paleographic error for **Μ**, as suggested by Schmidt.⁵

(h) [Hyalikos] -- See below note 7, page 47 f.

(i) Hyalinos (hyelinos) -- The adjectival form, hyalinos, occurs in literature before hyalos. In supporting his preference for α rather than ε in the word hyalos Phrynicus⁶ mentions the use of hyalinos by Corinna. This passage is extremely obscure, however, and although attempts to emend the word are certainly not justified, nothing can be learned about glass from the expression

¹ See below, page 56.

² Hesych. Υαλίης ή Σαλίευς· εἴκατος· βλοσυρός.

³ Theognostos, Canones, 18, 29: Σαλίνης εἴκατος, βλοσυρός.
Cf. Zonar. 1759: Σαλής· εἴκατος· βλοσυρός.

⁴ Hesych. Σανέοος· εἴκατος· βλοσυρός.

⁵ Hesych. (ed. Schmidt), note on Σαλίης. See Curtius, Gr. Etym. ed. 5, 565.

⁶ Phryn. 309: καὶ ἡ Κόριννα τὸν Σάλινον παῖδα θήσεις.
There have been numerous conjectures concerning this passage, for which see Lobeck on Phryn. 309, note a; Th. Bergk Poet. Lyr. Gr. 3, frag. 42. Once in a while hyalinos does mean 'glass-like,' and since skin is sometimes compared with glass because of its brightness, smoothness, or transparency, it is possible that Σάλινον παῖδα means a child with a clear, smooth complexion.

which is quoted. Aristophanes¹ is the first to speak of a vessel made of glass, and it is partly on his use of hyalinos that later grammarians base their preference for the spelling with a.²

Hyalinos³ was used over three centuries before hyelinos, which does not occur until the second century before Christ, more than a hundred years after hyelos. But from then on hyalinos⁴ and hyelinos⁵ are used with about the same degree of frequency. Occa-

¹ Ach. 74: ἐξ ὑαλίνων ἐκπαράτων. Quoted in
Pollux. 6, 100: Ἀριστοφάρνης δέ που ἔφη Ἐπίνοεν ἐξ ὑαλίνων
ἐκπαράτων. 10, 68: ἐν δὲ Ἀχαρνεῦσιν Ἀριστοφάρνους ἐξ ὑαλίνων ἐκπαράτων
καὶ χρυσίςσων.

² Photius, s.v. ὕαλος; Bachmann, Anecd. Gr. 1, 392 ff.; Miller, Mélanges, 290.

³ I G II 646, 4: ὕαλινοι[ρά]ργυρούν, σταθμού[ρ] [FIII]; I G II 652 R; I G II 656, 18: ὕαλινοι ἀργυρούν, σταθμού[ρ] τούτου FIII; I G II 682; IV 672 c; P. Flind. Petr. III 42 H, 73: ὕαλινη γενέσθαι
καὶ ψυτὸν τριτελεύει.

⁴ Hero, Pneumat. 1, 14, 214, 222, 234; Idem, Dioptric. 3, 200; Philodemus, de Morte, 39, 1 ff.; Strabo, 17, 1, 8; Hippocrates, Epist. 16 (ed. Kuhn, 23, 792); Rev. 4, 6; 15, 2; Damocrat. (in Galen 14, 99, 5); Epictetus, 3, 24, 84; Galen, 5, 838; 11, 875; 12, 490; 14, 48, 268, 392; Ael. Promotus (Wellmann, Corp. Med. Gr. 10, 1, 1, 9); Lucian, Ver. Hist. 1, 25, 27, 42; 2, 11, 14; Idem, Quomodo Hist. Conscrif. sit. 25; Paus. 2, 27, 3; Philumenus, de Venenatis Animal. 4, 15, ms. P has ὕαλη corrected to ὕαλη by Wellmann from Aelius Promotus, περὶ τοπόλων θηρίων (Corp. Med. Gr. 10, 1, 1, 9, 9); Athen. 5, 119 F; Ps. Callisthenes, 3, 31; Inscr. of Cos. (Paton-Hicks), 36; Hesych. s.v. ἄνηυθος; Damascius (Patr. Gr. 103, 1289 A); Paul Aeg. 87, 4; 126, 24; Id. Chirurgie, 348, 368; Theognostus, Can. 18, 29. The latter is an error probably caused by copying a corrupt passage in Hesychius. Bachmann, Anecd. Gr. 1, 256, 17; Suid. s.v. θηρίκλειον; Hippiatr. 1, 46, 48; Zonar. Lex. 1759; Etym. Magn. 774; Anthol. Pal. 14, 52 (of uncertain date).

⁵ Hero, Pneumat. 1, 8, 234, 236, 238, 240, 242; Dioscorides, 5, 110; Joseph. Bell. Iud. 2, 10, 2; Aelian, Var. Hist. 13, 3; Galen, 12, 631, 637, 660, 827; 13, 30, 56, 104, 746, 1010, 1045; 14, 293, 403, 406, 539, 568; Script. de Rebus Alex. (K. Müller, Ps. Callisth. 2, 38, 4); Athanasius (Patr. Gr. 28, 789 B); Basil. Homil. 6 (Patr. Gr. 31, 1473 D); Oribasius (Bussemaker-Daremburg 5, 199, 11); Titus Bost. Adv. Manichaeos, 2, 31 (Patr. Gr. 18, 1193 C); Cyril. Gloss (Hesych. ed. Schmidt, 4, 341); Alex. Aphr. Probl. 1, 132 (Ideler, 1, 45); Aetius, 1, 7 (Patr. Gr. 157, 164 or Scr. Hist. Byz. 37, 149); Philoponon Arist. de Anima, 320, 351, 429; on Arist. Meteor. 49; Paul. Aeg. 2, 3; 26, 21; 137; Photius (ed. Porson) s.v. θηρίκλειον; Script. Orig. Constant. 1, 93; 2, 168; Hippiatr. 1, 103; Theophan.

sionally they are spelled with a double lambda.¹

As the suffix -ino² indicates, hyalinos means 'of glass.' In most instances where it occurs, it is used of 'a utensil of glass,' 'a glass cup,' or 'a vessel made of glass.' Just as hyalos may stand for some other transparent substance, so hyalinos may mean 'of something which looks like glass.'³ Sometimes it is used in imaginary or suppositional cases, as 'a sea of glass,' 'a glassy humor of the eye.'⁴ The transparency of glass suggests such examples, as it does the comparison of the air with a glass window.⁵ Other characteristics of glass suggested by glass objects are hardness and smoothness.⁶ In a few instances hyalinos is employed with an unusual meaning. Josephus uses it to characterize sand.⁷ In this case it seems to have the meaning 'transparent like

Nonn. 1, 105; Geop. 9, 19, 11; 10, 7, 6; 10, 56, 6; 10, 691; 10, 70; Zonar. Lex. 1043; Anon. on Arist. Rhetor. 170; Etym. Magn. 451, 27; Demetrius, Hieracosophion, 205, 222; Joan. Actuarius, de Urinis, 33, 7; Nemes. de Nat. Hominis, 13 (Patr. Gr. 40, 665 A).

¹ Lucian, Ver. Hist. 2, 11 (Ms. N, Niélén); Ps. Callisthenes ed. Meus. 2, 38 (quoted from Crönert, Memor. Gr. Hercul. 75); Zonar. Lex. 1043.

² Brugmann-Thumb, Griech. Gram. ed. 4, 194: "Suffix -ino, -ina - ist b) von unklarem Ursprung in Adjektiven, die Stoff, Herkunft, Art bezeichnen."

³ Probably the coffins mentioned in Strabo 17, 1, 8; Aelian, Var. Hist. 13, 3, were simply of some substance that resembled glass (see above).

⁴ Rev. 4, 6: ἐνάπιον τοῦ θρόνου ὡς βάλανος βαλίνη. ὅμοία κρυστάλλῳ. Idem, 15, 2: ὡς βάλανος καὶ βαλίνη τεμαγρένη πυρί... ἐστῶται ἐπὶ τὸν βάλανον τὸν βαλίνην. The comparison with crystal here suggests that transparency was the principal idea in the mind of the author of Revelations. Philoponus on Arist. de Anima, 351, 32: ἀλλ' εἰ οὐ λίκην ἐπὶ τεθρένη σία τὸ μὲν εἶναι σιαφανῆς ἀντιφράττει τῷ φωτί, ἔδει, εἴπερ ἐπιτροπήν βαλίνη λίκην οὐ ἐξ ἀλλής σιαφανοῦς ὑλῆς, μὲν ἐκποσίζειν ἐπιτιθεμένην ἐν τῷ ὄφθαλμῷ, ὥστε δρασθαι αὐτήν.

⁵ Athanasius (Patr. Gr. 28, 789 B).

⁶ Philoponus on Arist. de Anima, 429: Εἰν τοιηρά πάντα καὶ λέπα τύμπατα λάροις, οἷον βέλινα καὶ χαλκαὶ στιλβωθέντα χρύσως.

⁷ Joseph. Bell. Iud. 2, 10, 2: τὸν βελίνην φάρμον (βελίνην, e i. ras. m. 2 L βελίνην VRC Niese). Thes. Gr. Ling. 8, 6 and Liddell and Scott

glass' rather than 'fit for the production of glass,' which is properly hyalitis. Similarly Basilius uses hyalinos in connection with a membrane.¹ It is possible that an anonymous writer on *Sancta Sophia* has employed hyalinos in the same way.²

(j) Hyalios (hyelios). -- The masculine form of the adjective, hyalios, appears only with the absurd definition polemios,³ probably from a false inference or confusion with Enyalios.⁴ The neuter hyalichn has the same meaning as hyalinos.⁵ Hyalion is also used as a substantive to stand for glass⁶

cite this passage under ὑάλινος and give it the meaning "suitable for making glass." I have been unable to find any authentic instance of hyalikos except in a corrupt and as it now stands quite unintelligible passage in Hesychius: ὑάλικος κώμη· Διονύσιος. ὑαλέασχορὸς πάτερ. Λάκωνες, where there is certainly no reference to 'glass.' The form ὑαλίκην in Josephus has no Ms. authority whatsoever and is due to a misprint in Havercamp's 1726 ed. of Hudson's text (London 1720) where ὑαλίκην is correctly printed.

¹Basil. Homil. 6 (Patr. Gr. 21, 1473 D): ἐφαίνετο γάρ, ὡσπερ φῶς ή ὑείνων ὑφένων, σία τοῦ ἀνθρωπίνου σώματος ἡ θεῖα δύναμις.

²Anon. Διηγήσις περὶ τῆς Ἁγίας Σοφίας (Script. Orig. Const. 1, 93 ff.): Κατεχρύσωσι ἐξ ὑείνου χρυσοῦ λαμπροτάτου. This might mean 'gold, like unto pure glass', but it is more probably the gold colored glass mosaic so common in early churches.

³Photius; Bachmann, Anecd. Gr. 1, 393: ὑάλιος· πολέμιος.

⁴Suid. ὑάλιος· πολέμιος καὶ Ἐρυάλιος. "Mihi videbatur καὶ ἐνυάλιος ab homine docto profectum fuisse, qui monstrum vocis ὑάλιος animadversum corrigeret," Bernhardy.

⁵I G II 645: ὑάλιον ἀργυροῦ κοστλοντ, Boeckh. "fortasse emendandum est ὑάλινον", Koehler. Suid. ὑέλιον· καὶ ψέλος. καὶ Σέλινον.

⁶Leo Gram. Chronographia (Script. Hist. Byz. 47, 215), Pieces of glass probably in the form of gems: τὰ δύο μέγιστα ὄργανα διόχρυτα σία φύροις λίθοις καὶ ὑείνοις καλλύρας αὐτά. Compare Georgius Monachus (Patr. Gr. 110, 1009). Demetrius, Hieracosophion. 275, one of the components of a plaster is ὑελίου μέρος ἐν. Codinus Curop. De officiis pal. Constantinop. 4 (Patr. Gr. 157, 40): καὶ τὸ τοῦτο σκαράκον τὸν βασιλέα εἰκονικῶς, ἐμπροσθετὲν ἰστάρενον ὑπὸ ὑελίου λεγομένου σία γελάστου.

as well as objects made of glass, such as cups,¹ mirrors,² and windows.³ It likewise designates the vitreous humors of the body.⁴

(k) Hyalitis (hyelitis).-- Hyalitis is applied to sand with the meaning 'that from which glass is made'.⁵

(l) [Hyalkadai].-- See above note 7, page 47.

¹Const. Porph. De cer. aulae Byz. 2, 44 (Script. Hist. Byz. 9, 661), gifts sent by the emperor to the king of Italy: ποτήροι
ἀνυκτούσι. Σέλια κλεοπτ. 15'. On the ε̄ for ᾱ see Psaltes, Gram. der byz. Chron. 4, 6.

²Suid. σπέκλαιν. τὸ οὐέλιον, τὸ σπέκλαιν. Compare Damasc. Stud. Homil. 25: ἐκύταξε εἰς τὸ οὐέλιον τὸ πρόσωπόν μού (quoted from Ducange).

³Anon. Διηγησις περὶ τῆς Ἀγίας Σοφίας (Script. Orig. Const. I, 90): Σέλια τῶν σελίων. Salmasius takes σπέκλαιν to mean window glass. Plin. Exercit. 770 b, G: "Graeci σέλια. Immo ita etiam appellarunt, etiamsi ex speculari lapide essent, non ex vitro. Neophytus monachus in Lexico Herbario: τὸ τοῦ φεγγίτου σέλιον, hoc est, vitreum ex speculari lapide. Quod fenestris obducebatur ad translucidum, ac lucem admittendam, specular veteres Latini vocarunt. . . 771a A. Idque ex speculari lapide qui est φεγγίτης, aut ex vitro fiebat, aut alia translucida materia... Haec specularia porro fenestris indita ad perspiciendum Graeci σέλια vocarunt, quae ex vitro fierent, Latini vitria... C. Neophytus σέλιον etiam vocat specular, quod ex phengite lapide, non ex vitro compositum est... E. Paulus Silentarius de fenestris templi sanctae Sophiae - Σοφηνία φωτὸς ἀροίγει, λεπταλέασις οὐέλοις κεκαυδημένοις. Haec sunt proprie quae σέλια dicuntur uno verbo Graecis, specularia nempe ex vitro."

⁴Niceph. Blemm. de Lib. Med. (Heisenberg, Nic Blem. Curr. Vit. et Carm. "In codice enim Vindob. Med. Graec. 45 saec. XIV haec opuscula exstant." 87 -- 3. a. fol. 30v | inc.: τῶν στρεψῶν σέλια 3 fol. 35v | inc. (same as above) Uno codice Vindob. Theol. Graec. 245 saec XV/ XVI. fol. 312r hic titulus praebetur: σιάγνωσις σελίων τοῦ οὐρανοῦ. See Ducange s.v. σέλιον.

⁵Theoph. de Lap. 49: ἐκ τῆς σελίτης. See Lobeck, Paralipom. 52. Strabo, 16, 758: τὴν οὐαλίτιν ἄμμον... οὐαλίτιν φάρμακον... οὐαλίτιν γῆν Eustath. Comm. on Dionys. Periegetes, 912: φάρμακος οὐαλίτης.

(m) Hyaloeis.-- Hyaloeis is defined by Hesychius¹ as transparent and bright. Rufinus² uses this form in describing a beauty whose cheeks are like glass.

(n) [Hyalomai].-- See above note 2, page 40.

(o) Hyalous (hyelous).-- See above page 43.

(p) Hyalōdēs (hyelōdēs).-- Although hyalinos and hyalous may occasionally denote 'glass-like' the words that usually convey that meaning are haloeidēs,³ or hyeloeidēs,⁴ (hyeloidēs),⁵ and halōdēs,⁶ or hyelōdēs.⁷

As early as the fifth century Philolaus describes the sun as "a glass-like (haloeidēs) body which receives the reflected

¹Hesych. s.v. ξαλόειν. Σικ φανέσ. λαρπτόν. Cf. Theognostus, Canones, 18, 29; Zonar. Lex. 1760; Philemon, Lex. Tech. 248: ξαλόειν. τὸ τιαφανέσ.

²Rufinus (Anthol. Pal. 5, 48): καὶ ξαλόεσσα παρεῖν.

³Hippocrates (Kuhn, 21, 289); Theoph. de Lapid. 5, 30; Rufus, 154, 165, 171, 597; Aët. 2, 20, 12 (Diels, Doxogr. Gr. 349); Galen, 3, 760; 761, 762, 766, 767, 768, 777, 779, 787, 789, 830; 4, 160, 5, 446, 623, 788; 6, 789; 7, 749; 10, 48; 14, 712; 16, 30; 19, 275; Pollux, 2, 71; Euseb. 15, 23; Orib. 3, 294 (from Galen), 295, 296, 298, 301, 302; Orphica, Lith. 280 (uncontracted), Theodoret, Gr. Affect. Cur. 105; Michael Glycas, Annal. 1, (Script. Hist. Byz. 27, 40, 3).

⁴Aët. 2, 25, 11 (Diels, Doxogr. Gr. 356); Ach. Tatius, Isagoge ad Arati Phaenom. 19; Cassius, Probl. 154; Stobaeus, I, 26, 1; Aëtius Amid. (Hirschberg, Die Augenheilkunde, I); Theophilus, de Corp. Hum. Fabr. 4, 15, 3; 19, 5.

⁵Cass. Probl. 27 (Ideler, Phys. et Med. Gr. 1, 154, 15 ff.).

⁶Hippocrates (Kuhn, 21, 254); Galen, 6, 255, 509; 7, 138, 347, 349; 8, 81, 82; 10, 870; 16, 11, 367, 585; 17, 1, 429, 848; Palladius, de Febr. Synopsis, 8, 1; 27, 2; Paul. Aeg. 46, 25; Theophilus, de Urinis, 8, 2 (Ideler, 1, 269); Leo Philos. Conspectus Medic. 3, 1; Theophan. Nonn. 170; Psellus, Carmen de Re Medica, 635.

⁷Dioscorides, 3, 86 (96); Galen, 13, 942; Meletius, de Nat. Hominis (Patr. Gr. 64, 1168).

light of the fire in the universe and transmits it to us.¹ Ion of Chios calls the moon hyeloeidē, "transparent like glass."² But the physicians make the greatest use of hyaloeidēs and hyalōdēs³ to describe the various humors and phlegms of the body⁴ and the vitreous

¹ Aët. 2, 28, 12 (Diels, Doxogr. 349 ff.): Φιλόλαος ὁ Πιθαγόρεις ὑαλοειδῆ τὸν ἄλιον, θερόμενον μὲν τοῦ ἐν τῷ κόσμῳ πυρὸς τὸν ἄγαν ταῦγειαν, συγθεῶντα δὲ πρὸς ἡμᾶς τὸ τε φῶς καὶ τὸν ἀλέαν, εἴστε πρόποντι τὸν διττοῦς ἄλιον γίγνεσθαι, τὸ ἀπ' αὐτοῦ πυροειδὲς κατὰ τὸ ἐσοπτροειδὲς.

Galen, 19, 275; Theodoret, Gr. Affect. Cur. 105. Plutarch and Galen omit τὸν ἀλέαν. Ach. Tat. Isagoge ad Arati Phaenom. 19: Φιλόλαος δὲ τὸ πυρῶδες καὶ διαυγὲς λαρύβαντα ἀνωθεν ἀπὸ τοῦ κιθερίου πυρὸς πρὸς ἡμᾶς πέρπτειν τὸν αὐγὴν διὰ τινῶν ἀραιωμάτων εἴστε κατ' αὐτὸν τρισσὸν εἴραι τὸν ἄλιον, τὸ μὲν ἀπὸ τοῦ αἰθερίου πυρός, τὸ δὲ ἀπὸ ἐκείνου περπόμενον ἐπὶ τὸν ὑελοειδῆ ὑπ' αὐτοῦ λεγόμενον ἄλιον, τὸ δὲ ἀπὸ τοῦ τοιούτου ἄλιον πρὸς ἡμᾶς περπόμενον.

Eusebius. 15, 23: θίσκον ἑαλοειδῆ. Michael Glycas, Annal. I (Script. Hist. Byz. 27, 40): Φιλόλαος δὲ ὑαλοειδῆ τοῦτον ἐφίλοσοφες θερόμενοι... ἡμᾶς. See A. Boeckh, Philolaos des Pythagoreers Lehren, 124 ff.; A. S. Pease on Cicero's de Div. 1, 97.

² Aët. Plac. 2, 25, 11 (Diels, Doxogr. 356): περὶ σελήνης αὐσίας. Ιων σῶμα τῇ μὲν ὑελοειδὲς διαυγές, τῇ δὲ ἀφεγγές.

³ This form of the word was widely used by the Middle Ages and early modern times, see Castelli, Lex. Med. s.v. Hyalodes.

⁴ Hippocrates, 21, 254: καὶ οὔρου πυῶδεος καὶ ὑαλῶδεος (ὑαλῶδεος A). Id. 21, 289: ἀφελέει δέ καὶ οὔρου διέξοδος ὑαλοειδῆς πολλή, καὶ ρύσις κοιλίης ρύσις. Praxagoras in Rufus, 154: Πραξαγόρας δὲ τοῖον τρόπον τούς χυρούς ὠτόματε, γλυκύν, καὶ ισοκρατον καὶ ὑαλοειδῆ. Id. in Galen, 6, 255: τὸν τοιούτον χυρὸν δὲ Πραξαγόρας ὑαλώδην καλεῖ. Compare Galen, 6, 509; 7, 138, 347, 349; 8, 81, 82; 10, 870; 16, 11, 585. Id. 16, 367: ὃν ὑαλώδην ἐκάλουν οἱ κατὰ Πραξαγόραν, δὲς ὑαλῷ κεχυμένῳ προσέοικε τὸν χροιάν καὶ τὸν σύστασιν.

Id. 17, 1, 429: τὸ γονοειδὲς δὲ οὔρον λέγεται, ὅταν οὐ καλούμενος ὑπὸ Πραξαγόρου χυρὸς ὑαλώδηνς ἐκκενούτας.

Id. 17, 1, 848: συντβαίνει δὲ τὰ τοιαῦτα ῥύγη διὰ ψυχρὸν πάνυ φλέγμα τὸ ὑαλώδες ὄνομαζόμενον ἢ τὸν μελαγχολικὸν χυρόν, ικτλ.

Of. Id. 979. Ον ἑαλοειδής see Id. 6, 789. Id. 7, 749: φλεγματώδης χυρὸς ψυχρός, ὃν δὲ Πραξαγόρας ὑαλοειδῆ καλεῖ.

Palladius, de Febr. Synopsis, 8, 1: ἐπὶ δὲ τοῦ φλέγματος τεσσαρές εἰσι διαφοραί. Εστι γάρ τὸ ὑαλώδες, τὸ ὄξωδες, τὸ ἀλυκόν, καὶ τὸ γλυκό. 8, 2: Καὶ τὸ μὲν ὑαλώδες καὶ ὄξωδες ποιεῖ τὰ ὄνειρά μαντείαν γίγνεται.

27, 2: διὰ τὸν τοῦ χυροῦ γένεσιν. τὸ γάρ ὑαλώδες καὶ ὄξωδες φλέγμα τὸ ἐποκείμενόν ἐστι.

Paul. Aeg. 46, 25: καὶ ποτε καὶ ὑαλώδες ἐπικρίνεσθαι φλέγμα. Theophilus, de Urinis, 8, 2: καὶ ἐτέρας διαφορὰς τοῦ φλέγματος, εἰς ἐστι τὸ ἑαλοειδὲς φλέγμα καὶ τὸ ἀλυκόν, καὶ τὸ ἄπολον. Theophan. Nonn. 170: κερωθέν γάρ ὑαλώδες φλέγμα, παύονται τῆς ὄδύνης. Psellus, Carmen de Re Medica, 596: τοῦ φλέγματος δὲ πολλαπλοῦ περικότος (τὸ μὲν γάρ τος ὑαλοειδές τυγχάνει, τὸ δὲ ἀλυκόν πέψυκεν, ὄξωδες τρίτον). τὸ δὲ γλυκείας ποιούτητός ἐστι πως), ὅπερ πέψυκεν ὡς ὑαλος τὸν φύσιν.

humor of the eye, the portion back of the crystalline lens.¹

Id. 635 ff.: ὁ διὰ πίσθιος συνθέτως κεκλυρένος ἀνθρημένος σύγγρανός πνευματικός πνεύματος τεταγμένος.

¹ Rufus (ed. Daremberg-Ruelle, 154), on the tunics of the eye: ὁ δὲ τρίτος περιέχει μὲν ὑαλοειδὲς ὑγρόν· παλετται δὲ αρχαῖον ὄνομα ἀραχνοειδῆς διὰ λεπτότητα... ἀλλοι δὲ καὶ ὑαλοειδῆς ἀπὸ τοῦ ὑγροῦ. ὁ δὲ τέταρτος περιέχει μὲν τὸ κρυσταλλοειδὲς ὑγρόν, ἀγάνυνθος δὲ ὡν ἐξ ἀρχῆς φακοειδῆς μὲν διὰ τὸ σχῆμα, κρυσταλλοειδῆς δὲ διὰ τὸ ὑγρὸν ἀνοράσθη.

Id. 171: ὁ δὲ τρίτος ἀπὸ τοῦ αὐτοῦ πόρου προελθῶν περιέχει ὑγρὸν [ψῶν] τῷ λευκῷ παραπλάσιον καλούμενον ὑαλοειδές, κτλ. Cf. Id. 597. For a reconstruction of the eye according to Rufus of Ephesus see prospectus, Studies in the History and Method of Science, ed. Charles Singer, Oxford, 1921. Galen, 3, 760 ff.: καὶ μέν γε ὡς εἰς ἐκάτερον αὐτῶν ἐκφύγεις ἔγκεφάλου καθῆκονται, πιλούμεναι μὲν κατὰ τὸν διὰ τῶν ὀστῶν δῶν ἐνεκα δυσπαθείας, ἐπειδὰν σ' εἰς αὐτοὺς ἀφίκωνται τοὺς διφθαλμούς, αὖθις λιόμεναι τε καὶ πλακτυρόμεναι, καὶ περιλκυβάνονται μὲν ἐν κύκλῳ χιτῶνος δικῆν τὸ ὑαλοειδὲς ὑγρόν, ἐμφυόμεναι δὲ εἰς τὸ κρυσταλλοειδές. καὶ γάρ καὶ ταῦτα εἴρηται πρόσθεν, καὶ ὡς αὐτὸν τὸ κρυσταλλοειδὲς ὑγρὸν τὸ πρῶτον ἐστιν ὄργανον τῆς ὄψεως.

Cf. Id. 3, 777, 779, 787, 830; 4, 160; 5, 446. Id. 5, 623: εὑρήσεις γάρ ὑπὸ τοῖς χιτῶνις ἔνδον ὑγρὰ σφαιροειδῆ σίττα, τὸ μὲν οὔτω τραλακόν, οὔτε πέρ ἐστιν ὑαλος οὐτερίως λιθετόν, τὸ δὲ οὔτω σκληρόν, οὗτος διμετρίως παγεῖς κρύσταλλος. ὄνομά γεται διὰ ὑπὸ τῶν ἱετῶν ὑαλοειδές μὲν τὸ τραλακότερον, κρυσταλλοειδές δὲ τὸ σκληρότερον, ἀπὸ τῆς πρὸς ὑαλόν τε καὶ κρύσταλλον δροιδτητος, οἷς οὐράνον ταῖς συστάσεσιν, ἀλλὰ καὶ τὰς χρωμάτους ἔοικεν ἀκριβῶς γάρ ἐστιν καθαρά, καὶ διευγύνει, καὶ λαμπρά, κτλ.

Cf. Id. 5, 788; 10, 48, 760, 762, 766, 767, 768; 15, 712; 16, 30. Pollux (ed. Bethe), 2, 70: τὰ μέρη δέ τῶν ὀφθαλμῶν χιτῶνας ἐκάλεσαν οἱ ἱατροί. τέτταρες δὲ εἰσὶ τὸν ἀριθμὸν... 71: τῷ δέ τρίτῳ, φακοειδέται, καὶ κρυσταλλοειδέται, καὶ ἔχαλοειδέται.

Compare Orib. 3, 294 ff. (295): καὶ τοῖς γυναικαῖς καὶ γένονται παρεσκεύασται πρὸς τῆς φύσεως ἐπιτίγμειος αὐτῷ τροφὴν τὸ ὑαλοειδὲς ὑγρόν, δύσιν παχύτερον καὶ λευκότερον αἵματος, τοσούτῳ τοῦ κρυσταλλοειδοῦς ἀπολειπόμενον παχύτητί τε καὶ φακότητι... δῆλον δέ τοι ὡς πατέται διάδοσιν τρέφεται, τὸ μὲν κρυσταλλοειδὲς ζητοῦν ὑαλοειδοῦς, τὸ δέ ὑαλοειδές ἐκ τοῦ περιέχοντος αὐτὸν σώματος, δὲ πλακτυνθείσης τῆς ἄκνωθεν κατίουρης ἔγκεφάλου μοίρας ἐγένετο, κτλ. Id. 3, 297: ὥστε διὰ τῶν μέσων σωμάτων τὸ ὑαλοειδὲς ὑγρὸν τῷ πάντων ἐξωθεν ἄγνωται χιτῶνι, τὸ τραλακώτατον τῷ σκληροτάτῳ. Id. 3, 301: οὐδὲν δέ οὔτε τὸν αὐτῆς θαυμάγω καὶ τὸν ἐπιτραχεῖσκον ἐντὸς δασύτητα τῷ περιέχοντι τὸ ὑαλοειδὲς ὑγρὸν χιτῶνι· νοτέρα γάρ αὕτη καὶ μαλβακὴ καθάπερ σπουγγί, τοῦ κρυσταλλοειδοῦς ὑγροῦ φανουσα. τὸν τοῦ χιτῶνος ὅλου γειτνίσσιν ἀδιπονατῷ παρέχει

Cass. Iatr. Probl. 27 (Ideler, 1, 154): τούτο κατάδηλον, δτι ὀφθαλμὸς ὑγρὰ περιέχει· τό τε ὑδατῶσες, ἀφ' οὐ τὸ βάκρυον, καὶ τὸ κρυσταλλοειδὲς καὶ τὸ ὑαλοειδές. Theod. Prisc. 4, 2, extr.: humorum vitreum, quem Graeci hialoiden vocent. Georges, Ausführliches latein.-deutsch. Handwörterb ed. 8, 1, 2, and Harper's Lex. incorrectly translate as 'glassgreen.' Aët. Amid. WHirschberg,

Besides the sun, the moon and humors, a few other things, such as gems,¹ gum,² and asphalt,³ are called 'glasslike.' Objects or substances so designated would seem to be either transparent, occasionally with the additional idea of the consistency of glass in the liquified state, or glistening, or else hard and brittle, as the context requires.

(q) Hyalôma.-- Hyalôma⁴ is a disease of the eye, glaucoma, in which the vitreous humor becomes opaque.

(r) hyalôps.-- See below page 54.

Die Augenheilkunde I: Κύρια δὲ ἔστιν ἐν τῷ ὄφθαλμῷ τρία· ἐνδοθεν μὲν πάγτων τὸ περιεχόμενον ἐν τῇ κοιλότητι τοῦ ἀρφίβλητροειδούς χιτῶνος οὐδεὶς λεγόμενον, κτλ. Theophilus, de Corp. Hum. Fabr. 4, 15, 3 (ed. Greenhill, 152): ἐν γὰρ τῷ ὄφθαλμῷ τρίαν κύρων ὄντων, τοῦ κρυσταλλοειδοῦς, τοῦ ὑελοειδοῦς, καὶ τοῦ ωοειδοῦς, πρῶτον ὄργανον ὄρατικὸν τὸ κρυσταλλοειδὲς ἐγένετο, τὰ δὲ ἄλλα τροφῆς ἐνέκεν. 4, 19, 5 (159): ἡ δὲ λεπτὴ κύριγξ σὺν τῷ νεύρῳ πλατυομέγη γενῆ τὸν ἀρφίβλητροειδῆ χιτῶνα. ἐπεκτενύμενος δὲ ὁ ἀρφίβλητος εἰδῆς χιτῶν περιέχων καὶ τὸ ὑελοειδὲς ὑγρὸν συρπαραλαβάνει τὸν ρυγοειδῆ χιτῶνα, περιέχοντα τὸ κρυσταλλοειδὲς ὑγρόν, καὶ μέρος τι τοῦ ὑελοειδοῦς εἰς τροφὴν τοῦ κρυσταλλοειδοῦς.

Meletius, de Nat. Hominis (Patr. Gr. 64, 1168): εἰσὶ δὲ τὰ τοῦ ὄφθαλμοῦ κύρια τὸν ἀρθρὸν τρία. καὶ πρῶτον μὲν ἔστι τὸ ὑελῶδες ὅτι κατὰ τὸ μέσον ἔγκειται τοῦ ὄπτικοῦ πόρου. ὅθεν διεσπαρτέραι τρεις ποιοῦσι τὸν ἀρφίβλητροειδῆ. καλοῦσι δὲ ὑελῶδες τοῦτο τὸ ὑγρόν, ὅτι περ πακτικήσιον ἔστιν ὑέλω, κατὰ τε τὸ χρώμα καὶ κατὰ τὴν σύστασιν.

Leo Philos. Conspect. Medic. 3, 1: εἰσὶ τρία κύρια· τὸ διάδεινον, λευκόμενον, ἐπειδὴ ἔστι κενόλω.

¹ Theophrastus, de Lapid. 30: ἐξ ὧν δὲ τὰ σφραγίδια ποιεῖται καὶ ἄλλαι πλείους εἰσίν, οἷον ἡθύναλοειδῆς ἢ καὶ ἔμφασιν ποιεῖ καὶ διάφασιν, καὶ τὸ ἀρθράκιον, καὶ ἡ ὄπη φράξ. Orphica, Lith. 280: ἐσθλοὶ δ' αὗται ἐπὶ τοῖσι καὶ διάλοειδεῖς εἴραται κλείονται θυητοτοις θυητολέουσι τόπαχοι.

² Dioscorides, 3, 86 (96): de Euphorbio: ἔστι δὲ δύο γένη τοῦ ὄπου, τὸ πλέον διαυγέσ, ὡς σαρκοκόλλα, κατὰ μέγεθος ὄρόβρους, τὸ δέ τι ἐν ταῖς κοιλίαις ὑελῶδες καὶ συνεστώς.

³ Damocrates in Galen, 13, 942: πυκνῆς τε ὑελῶδους πρόσβαλλος φάλτου βίης, probably brittle and glistening like obsidian (a natural glass).

⁴ Apsyrtus in Hippiatr. 1, 11: Ἀψύρτου περὶ ὄφθαλμῶν λευκώματος... γλαυκώματος δὲ γεγονότος, περιέργον καὶ τὸ φλεβοτοκεῖν. ἔστι γὰρ ἀθεραπεύτον. συρβαίνει δὲ ἐκ τούτου ὁ καλεῖται γάλωρα, ὄροιον ψηφίδι λευκῆ.

5. Compound Derivatives: (a) [Hyelakykades].-- In Crinagoras,¹ where he is describing pears offered to Pan, hyelakykades occurs. Many emendations have been offered for this form,² nearly all of which agree that there is something glass-like about the pears. Some kinds of ripe pears do, of course, look shiny and semi-transparent.

(b) Hyelepsēs.-- The glass-smelter is designated by a special word,³ which varies in form and spelling, hyelepsēs,⁴ hyelepsos,⁵ hyalopsos,⁶ (hyelopsos),⁷ hyalōps,⁸ and hyeloepsos.⁹

(c) Hyelepsos.-- See above.

¹Anth. Pal. 6, 232: θελακυκάδες ὥγγαται.

²See Stadtmueller, Anth. Gr. 1, 350 ff.: "ΙΣ Σ θελακυκάδες (hyphen, accentum AC) Π | θελοκυκάδες αρ. L. θελοκυκάδες Ηεκκ. (αἱ φελιπίδακες Geist θαλοχρώδεες Βγ. θετοκυκάδες Reiske θελοούδακες Τουρ θελο-μηράδες Picc. εὐθάλα κυκλάδες Jac. θελοχυλάδες Εμπετ)." ++

³Friedrich (Rhein. Jahrb. 74, 172; Blümner: Tech.u.Term. 4, 384.

⁴Hesych. θελέψης θελο... "θελο τέχνης" Mus., qui compendium superscriptum delevit." Olympiod. on Arist. Meteor. 2, 228: παρὰ τοῖς θελέψαις. The Aldine edition has a double lambda.

⁵Michael Glycas, Annal. 4, 506, 7: δ θελέψης. Psaltes, Gram. der Byz. Chron. 4, 6. Compare Leontius Cyprius (Patr. Gr. 93, 1736 D); Act. Sanct. Iuli. T. I, 168, 16; 164, 52 (quoted in Thes. under θελέψης). Blümner, Tech. u. Term. 4, 389, n. 2, quotes Act. Sanct. Juli. T. I, 164, as τοῦ θελέψη, a passage which I have been unable to verify.

⁶Joan. Moschus, Prat. Spirit. (Patr. Gr. 87, 2932 A): θαλοψής. Schol. on Luc. Lexiph. 7.

⁷Cedremus (Script. Hist. Byz. 34, 687, 1): θελοψής. With double lambda, Herod. Epim. 138: θελλοψής.

⁸Pallad. Schol. on Hippocrates, 2, 222: δ θάλωψ. See Lobeck, Paralipom. 291.

⁹Niceph. Blemmy-des, de Fabr. Auri Cod. Reg. 2329, 159v: εἰς κάρπιον θελοεψού, Hase (quoted from Thes. Gr. Ling. 8, 6).

(d) [Hyelinopoios].-- For some time Yilinopoios, a word found in an inscription of Sparta of the first century before Christ, was thought to stand for hyelinopoios, 'one who makes things of glass,'¹ but the correction of this to psilinopoios, 'maker of palm garlands' has been universally accepted.²

(e) Hyaloëides (hyaloëides).-- See above page 50.

(f) Hyeloepsos.-- See above page 54.

(g) [Hyalokeras].-- An error, see above note 5, page 34.

(h) Hyalotechnes.-- See above note 4, page 54.

(i) Hyalourgeion.-- See below page 56.

(j) [Hyalourgia].-- See below note 1, page 50.

(k) Hyelourgikos.-- See below page 56.

(l) Hyalourgos (hyelourgos).-- Strabo is the first to mention the hyalourgos vitréarius,³ 'glass-maker.'⁴ The same form occurs in a list of traders and artificers in the Tebtunis Papyri,⁵ and spelled with an epsilon, in extracts from Julian of Ascalon.⁶

¹F. Welcher (Bull. Inst. 1844, 147): Νικοκλῆς ἐκ Τυρσάπους ὑλούρτοιος.

²Conge-Michaelis (Annal. dell' Inst. 1861, 39): φιλούρτοιος. I G V 1, 209.

³Corp. Gloss. Lat. vitrearius, ὑαλουργός.

⁴Strabo, 16, 758: παρὰ τῷ σαλουργῷ. See Salmas. Plin. Exercit. 769 a E.

⁵P. Teb. 2, 270: ὑαλουργός.

⁶Const. Harmenopulus, Manuale legum, 2, 4, 19: περὶ σελουργῶν... ὑελουργούς. Jules Nicole, Le livre du préfet, 71, Gen. Ms.: περὶ σελλουργῶν... ὑελουργούς.

Corresponding forms are hyalourgeion, 'the place where glass is made'¹ and hyalourgikos, 'of or for making glass.'²

(m) Hyalochroos.-- Leonidas³ mentions a glass-colored band. It is very difficult for us with our colorless glass to understand what hyalochroos, 'glass-colored' means, but most ancient glass, unless artificially colored, has a greenish cast. Among the Romans vitreus seems to have been used occasionally to express glass-green,⁴ probably in imitation of the Greek, although no instances of such a use occur in Greek literature. A passage has already been noted where Dioscorides describes resin as 'like glass in color' probably to express its transparency.⁵ It may not be impossible to consider 'glass-colored' when applied to a garment, as a reference to the sheerness of the material, but it seems more

¹ Diosc. 5, 181: ἐκ τῶν σελουργείων. "ὑελαυργός, vitriarius, qui vitra conficit. Bud. ex Dioscor. [5, 181, ubi hodie ex correct. Sarac. et J. G. Schneideri legitur ἐκ τῶν σελουργείων, quod v. Hase]" (quoted from Thes. Gr. Ling. 8, 9. Paul. Aeg. 106v, 10: ἐκ τῶν σελουργῶν. Hase in Thes. suggests that this should be written σελουργείων, which seems probable since σελουργία could hardly mean a workshop where glass was manufactured, which seems to be the meaning required here, or in Dioscorides from whom this passage is quoted.

² David. Proleg. et in Porphyr. Isogogen, 20, 11 ff.: σελουργική επτι τέχνη. Compare Nicephorus Blemmida, Epit. log. (Patr. Gr. 142, 697). Geop. 20, 16: εἰς κάρπινον σελουργικήν.

³ Anth. Pal. 6, 211, among the things dedicated by Calliclea to Cyprus: καὶ τηλούχον σελόχροα. Various meanings have been suggested. Dübner translates "vitricolore," but in the notes gives, "Caerulei, subviridis," quoting Brunck who rejects the suggestion of Larcher that the word meant 'transparent.'

⁴ Blümner, Farbenbezeichnungen bei den rom. Dichtern, 218.

⁵ See above page 44.

probable that a light green hue is meant.

(n) Hyalopsos (hyelopsos).-- See above page 54.

(o) Hyelôpizô.-- See below under hyelope.

(p) Hyalôpis.-- The transparency of the jasper is expressed by hyalôpis.¹

(q) Hyelôpê.-- Hyelôpê is a disease of the eye among hawks, and the corresponding verb, describing the condition of the eye in this disease, is hyelôpizein.²

(r) Hylaithos.-- Fick³ would derive Hylaithos, a river in west Locris, from hyalos and aitho. The appearance of water would be well described by such a name as 'glass-shining,' but the etymology is more than dubious, as the first element is not Hyal- but Hyl-.

(s) Hypohyelion.-- The form hypohyelion⁴ seems to mean 'covered over with glass' or 'something that looks like glass.'

¹ Orph. Lith. 613: ἐν γάρ οἱ σκέισ ὄρόων θάλαττιν ἔστιν τάρσιά θ' αἱρατόεντα καὶ αἰγλόεντα μάργυρον.

² Demetrius: Ὁρεοσοφίον ἀγροικοτερος 122: εἰς θελωπῆν ὄφθαλμον. ἐὰν δὲ ἔρεις θελωπίσῃ τοὺς ὄφθαλμούς, οὕτως αὐτὸν νοίσεις... ἔλον καπαρίσσιον λεπτὸν ποιήσεις καὶ πυρώσας εἰς τὸν αὐτὸν ρίνα ἔμβαλε αὐτὸν ἐκ τρίτου, δ τούτην θελωπῆν ἔστι.

³ A. Fick (Bezz. Beitrage, XXII, 63).

⁴ Codinus Curop. de Officiis Pal. Constantinop. 4 (Patr. Gr. 157, 40, 4): τὸ δικανίκιον τοῦ πρωτοβερτιαρίου χρυσοπράσινον, χρυσοχοίκον, ψπούελιον. "Cod. alter-i ἐπὶ εἰσιον" according to DuCange on δέλιος, vitreus.

D. Krystallos

Since hyalos, as I have already shown, is occasionally used for krystallos, one might naturally expect to find the reverse, either because glass was actually mistaken for crystal, or because krystallos was employed as a figurative equivalent for hyalos.¹

The resemblance of rock-crystal to ice, the original meaning of krystallos,² led to its being designated by the same word.³ In spite of the great similarity in the appearance of glass, it does not seem to have been called crystal in the early literature, at

¹ In Latin poetry crystallum, in Blümner's opinion (Tech. u. Term. 4, 386), appears not infrequently for vitrum, but the Thesaurus L. L. does not seem to recognize that meaning, at least explicitly. In view of the extreme scarcity of actual rock-crystal among ancient remains, as compared with glass, it appears almost certain that crystallum must frequently mean nothing more than glass, but it is difficult to prove this for any particular passage. Thus, for example, it probably would be impossible to show from the great majority of references to it in literature, that in English a 'watch crystal' is not actually made of 'crystal,' but regularly of glass.

This topic will be taken up later in a discussion similar to the foregoing on the Latin words for glass.

² Il. 22, 152 (151): *ἥδ' ἔτέρη θέρει προρέει εἰκυῖα χαλάζην | ἢ χιόνι ψυχρὴν ἢ ἐξ θεατος κρυσταλλω.*
Od. 14, 477 (475): *νῦν δ' ἄρ' ἐπῆλθε κακὴ Βορέαο πεσόντος, | πηγυδις. | οὐτέρ ψερθε χιών γένεται πότε πάχνη, | ψυχρή, καὶ σακέεσσοι περιτρέφετο κρυσταλλος.*
Hdt. 4, 28: *ἥδε δέλασσα πήγυνται καὶ ὁ Βόσπορος πᾶς δ Κιρκέριος, καὶ ἐπὶ τοῦ κρυστάλλου οἱ ἐντὸς τέφρου Σκύθαι κατοικημένοι στρατεύονται καὶ τὰς ἀμένας ἐπελαύνουσι πέριν ἐς τοὺς Σέρδους.*
Leo Meyer, Handb. d. gr. Ety. 2, 415; E. Boisacq, Dict. Ety. de la Lang. Grec. 522.

³ Strabo, 15, 67, of India: *φέρει δέ καὶ λιθαντὸν καὶ χώρα πολυτελῆ κρυστάλλων καὶ ἀνθράκων παντοίων, καθάπερ τῶν μαργαριτῶν.*
Ael. N. A. 15, 8: *δέ ἐν Ινδίᾳ χερσαργος οὐ λέγεται φύσιν ἔχειν ιδίαν, ἀλλὰ ἀπογέννητα εἶναι κρυστάλλου, οὐ τοῦ ἐκ τῶν παγετῶν συνισταμένου, ἀλλὰ τοῦ ὄρυκτοῦ.*

least, but the two are constantly associated.¹ The adjectival forms krystalloëides and hyaloeides also frequently occur in close relationship. Some of the early philosophers described the heavens and the heavenly bodies as 'like crystal'² while others preferred to speak of them as 'like glass.'³ The physicians designated part of the eye as the crystalline lense, from the character of its humor, and the part next to it as the vitreous humor for a similar reason.⁴

Although Hesychius⁵ says that krystallos is a 'kind of glass,' if the Greeks occasionally called glass 'crystal' (as the Romans seem to have done, see above n.1, p.58) it is difficult in any particular passage to be certain of it. In the following instances only does it seem probable that glass was the actual substance which is called crystal. Diodorus⁶ composed an epigram

¹ P. Holm. i. 5: κρυστάλλου μάλαξις τραγείω αἴρατι γέος μάλαξος. Τὸ δὲ αὐτὸς καὶ Σέλη. Andreas Caes. on Revelations, 21, 21 (Patr. Gr. 106): καὶ ἡ πλατεῖα τῆς πόλεως, χρυσὸν καθαρὸν ὡς ψαλος διαυγῆς... Σίδιος Τύρου πλατεῖαν τῆς πόλεως, διὰ μὲν τὸ πολυτελὲς καὶ εὔχρουν, ὡς χρυσίον, διὰ δὲ τὸ καθαρόν, ὡς κρυστάλλου ἔθεαστατο, [κατοι γέται ψαλος διαυγῆ] ἀπέρ ἀργότερον ἐν ἐνὶ συνδραπεῖν παρ' ἡμῖν, ἀδύνατον.

² Aët. 2, 14, 3 (Diels, Doxogr. Gr. 344): Ἄναξιτέρνυσικιν δίκιν καταπεπηγένει τὰ δεστρά τῷ κρυστάλλοεισετ. Id. 2, 11, 2 (Doxogr. Gr. 339): Ἐρπεδοκλῆς στερεμνιον εἶναι τὸν οὐρανὸν ἐξ ἀέρος συρταγέντος ὑπὸ πυρὸς κρυστάλλοεισῶς, τὸ πυρῶς εσ καὶ τὸ ἀερῶς εσ ἐγ ἐκατέρω τῶν ἀττικῶν περιέχοντα. Lactant de Opif. Dei, 17, 6: an si mihi quispiam dixerit aeneum esse caelum aut vitreum aut, ut Empedocles ait, aerem glaciatum, statimne assentiar? Aët: 2, 20, 13 (Doxogr. Gr. 350): Ἐρπεδοκλῆς δύο ἀλίους... τὸν δὲ φαινόμενον, ἀνταύγειαν, ἐν τῷ ἐτέρῳ ἄντιοφαιρίῳ τῷ τοῦ ἀέρος τοῦ δερμοτύγους πεπληρωμένῳ, ἀπὸ κυκλοτεροῦς τῆς γῆς κατ' ἀγάκλασιν γιγνομένην εἰς τὸν ἄλιον κρυστάλλοεισῆ.

Cf. Diog. Laert. 8, 77.

³ See above page 50 ff.

⁴ See above n. 1, page 52.

⁵ Hesych. κρύσταλλος · εἴδος Σέλα[λ]ου. On the spelling see Thes. 4, 2018 B.

⁶ Anth. Pal. 9,776: εἰσ κρύσταλλον γεγλυπτέντες. Ζεύξις οὐ χροι τε

upon a piece of carved crystal. Now in Greece real crystal seems to have been comparatively rare, but by the first century after Christ glass was common. Actual painting upon carved crystal or glass is no doubt possible, but it is difficult and one might be disposed to think that it would have been hardly satisfactory for a small piece such as this was. I am therefore inclined to think that chroïē, the exquisite tinting which reminded the poet of Zeuxis, refers to the beauty of the color of the carved glass, for carved glass was well known and relatively common, while I know of no instance of carved and tinted crystal.

Leonidas of Alexandria¹ mentions crystal, silver, and topazes as rich birthday gifts for Agrippina. Here nothing would suggest that crystal stands for glass except the fact that the author lived in the great center of glass manufacturing in antiquity. Pausanius² says that 'glass, crystal, and morria and everything else made of stone' are broken by the water of the Styx. He is probably thinking of krystallos as an artificial product, probably a colorless, transparent glass³ such as the variety which Strabo⁴ calls krystallophanē.⁵ In an epigram upon crystal containing water,

καὶ ἡ χάρις· ἐν σέ με τικρῆ Ικρυστάλλῳ τὸ καλὸν δαιδαλον Ἀραιόνη |
γράφεις ταῦτα ἐπορεύεται Σατυρίος. εἰρὶ δ' ἀνάστοιτεικών, καὶ μεγάλης
λείπομαι οὐδεὶς δλίγον.

¹ Anth. Pal. 6, 329: ἄλλος μὲν κρύσταλλον, ὁ δ' χρυσόν, οἱ δὲ
τοπάχους | πέρφουσιν, πλούτου δῶρα γενεθλίδια.

² Paus. 8, 18, 5: ὑδατος μὲν γε καὶ κρύσταλλος καὶ μόρρια καὶ ὄστα
ἐρτίν κανθρώποις ἄλλα λίθου ποιούμενα καὶ τῶν οκεανῶν τὰ κερατεῖα,
τὰ μὲν επὶ τῆς Στυγὸς τοῦ ὄδατος ψύγγυται.

³ Kisa, Das Glas, 2, 544.

⁴ Strabo, 16, 758: καὶ ἐν Ρώμῃ σὲ πολλὰ παρευρίσκεσθαι φέσι καὶ πρὸς
τὰς χρόας καὶ πρὸς τὰν ῥαστώνην τὰς κατασκευῆς, καθάπερ ἐπὶ τῶν
κρυσταλλοφανῶν.

⁵ Liddell and Scott define τὰ κρυσταλλοφανῆ as 'glass-ware,' but
of course Strabo merely means that one variety of glass,
τὰ κρυσταλλοφανῆ, was highly transparent, 'clear as crystal.'

Claudian¹ says that it was fashioned by man. It is difficult to understand how a sphere of crystal could be formed so that it could contain water, whereas glass could easily be blown into such a shape.

¹ Anth. Pal. 9, 753: εἰς κρύσταλλον ἔρδον ὕδωρ ἔχουσαν. χιονέη
κρύσταλλος ὑπ' ἀνέρος ἀσκηθετοσα| δετέξεν ἀκηραστοο παναίσολον
εἰκόνα κόσμου, | ούρανον ἀγκάσ ἔχοντα βαρύκτυπον ἔρδοθι πόντον.

E. Morria

A certain variety of glass seems to have been called morria. Since there are but two references to it in Greek literature, little can be learned of its nature from that source. In both instances, however, it seems to be an artificial product. In the Periplus of the Red Sea it is mentioned with lithia hyalē as manufactured at Diospolis for foreign trade.¹ Pausanias classes it with glass and crystal and everything else made of stone.² In Latin there is a more frequent use of murra, especially in connection with the vasa murrina,³ but only two authors give any suggestion of its nature. Propertius speaks of "murrine goblets cooked in Parthian ovens."⁴ Pliny, however, describes it as a natural product⁵ first introduced into Rome by Pompey the Great.⁶ He also

¹ Perpl. Maris/ Erythr. 6: καὶ λιθίας οὐλῆς πλεῖστα γένη καὶ ἄλλας πούρρινας, τῆς γίνομέν τοις ἐν Διοσπόλει. Salmas. Plin. Exercit. 769 a G: τῆς οὐλῆς πούρρινα.

² Paus. 8, 18, 5: μούρρινα. ³ Mart. 9, 39; 10, 80; 13, 110; 14, 113; Juv. 2, Satura 6, 155 ff.; Seu. de Benef. 7, 9, 3; Theonas (Patr. Gr. 10, 1572 D).

⁴ Prop. 4, 5, 26: murreaque in Parthis pocula cocta focis.

⁵ Pliny, N.H. 33, 5: murrina ex eadem tellure et crystallina effodimus, quibus pretium faceret ipsa fragilitas. Id. 37, 21 ff.: oriens myrrhina mittit inveniuntur ibi pluribus locis nec insignibus, maxime Parthici regni, praecipua tamen in Carmania umorem sub terra putant calore densari. amplitudine numquam parvos excedunt abacos, crassitudine raro quanta dicta sunt potoria. splendor est iis sine viribus nitorque verius quam splendor. sed in pretio varietas colorum subinde circumagentibus se maculis in purpuram candoremque et tertium ex utroque, ignescente veluti per transitum coloris purpura aut rubescente lacteo. sunt qui maxime in iis laudent extremitates et quosdam colorum repercussus, quales in caelesti arcu spectantur. iam aliis maculae pingues placent tralucere quicquam aut pallere vitium est -- itemque sales verrucaeque non eminentes, sed, ut in corpore etiam, plerumque sessiles. aliqua et in odore commendatio est.

⁶ Id. 37, 18 ff.: eadem victoria primum in urbem myrrhina invexit, primusque Pompeius capides et pocula ex eo triumpho Capitolino Iovi

refers to an imitation in glass.¹ Some scholars have conjectured that murra was a porcelain, others have tried to identify it with a precious or semi-precious stone, such as onyx or sardonyx, which could easily be imitated.² As Kisa has shown, the only murra which has been preserved, at least, is an artificial glass product, namely the Millefiori or glass-mosaic.³

dicavit. quae protinus ad hominum transiere, abacis etiam escariisque vasis expetitis; et crescit in dies eius luxuria. myrrhino LXX H S empto, capaci plane ad sextarios tres calice, potavit ... anus consularis, ob amorem adroso margine eius, ut tamen iniuria illa pretium augeret; neque est hodie myrrhini alterius praestantior indicatura, idem in reliquis generis eius quantum voraverit, licet aestimare ex multitudine, quae tanta fuit, ut auferente liberis eius Nerone exposita occuparent theatrum peculiare trans Tiberim in hortis, quod a populo impericante se dum Pompeiano proludit, etiam Neroni satis erat. vidi tunc adnumerari unius scyphi fracti membra. quae in dolorem, credo, saeculi invidiamque Fortunae tamquam Alexandri Magni corpus in condidorio servari, ut ostentarentur, placebat. T. Petronius consularis moriturus invidia Neronis, ut mensam eius exheredaret, trullam myrrhinam H S CCC emptam fregit; sed Nero, ut par erat principem, vicit omnes H S IX capidem unam parando. Memoranda res tanti imperatorem patremque patriae bibisse!

¹Id. 36, 198.: fit et album et murrina aut hyacinthos sappiroisque imitatum.

²For literature on the subject and a discussion of the different views, see Marquardt, Rom. Privatalt. 744 ff.; Becker-Göll, Gallus, 2, 385 ff.; Kisa, Das Glas im Altert. 2, 546 ff.

³Kisa, Das Glas im Altert. 2, 532 ff. Cf. Morin-Jean (Daremburg-Saglio, 5, 941).

III. THE MANUFACTURE OF GLASS

A. Traditional Origin

By far the earliest glass known comes from Egypt, where it had been manufactured for so many centuries that probably no record of its discovery remained when the Greeks began to interest themselves in the substance. At a relatively early time, however, the Phoenicians devoted themselves to the manufacture of glass, and that with such success that the one tradition which has come down from antiquity regarding its discovery ascribes it to navigators along the Phoenician coast. The account as given by Pliny¹ runs: "According to tradition a ship of natron merchants came to shore and when the men were scattered all along the beach preparing the meal, since there were no stones to support their kettles, they put pieces of natron from the ship under them. When these had caught on fire and the sand of the shore ^{mixed} with them, there flowed transparent streams of a new substance, and this was the origin of glass." Some attempt has been made to rationalize the

¹Pliny, N.H. 36, 191: (190, pars Syriae, quae Phoenice vocatur. . .) fama est ad pulsa nave mercatorum nitri, cum sparsi per litus epulas pararent nec esset cortinis attollendis lapidum occasio, glaebas nitri e nave subdidisse, quibus accensis, permixta harena litoris, tralucentes novi liquoris fluxisse rivos, et hanc fuisse originem vitri.

1 story, but scientists seem to be agreed that it is technically impossible.²

¹Froehner, La Verrerie, 2 ff.: "Pour moi, l'erreur de Pline est tout entière dans sa dernière phrase: 'telle fut l'origine du verre'; s'il avait dit: 'telle fut l'origine de la fabrication du verre au moyen du sel de nitre,' on n'aurait plus aucune objection à hasarder. Les peuples qui ont connu le verre avant les Phéniciens, n'employaient, comme fondant, que la potasse, c'est-à dire un alcali végétal, obtenu au moyen de la combustion de certaines plantes. La Phénicie eut le mérite de remplacer ces soudes imparfaites par l'alcali minéral, le fondant par excellence et sans lequel il est impossible de fabriquer des verres transparents." The latter part of this statement is very properly, it would seem, objected to by Friedrich (Rhein. Jahrb. 74, 168).

²Blümner, Tech. u. Term. 4, 380, 1; Morin-Jean (Daremburg-Saglio 5, 936).

B. Materials

The chief materials mentioned in the composition of ancient glass are silicates and alkalis. Sand, the silicate usually employed, was also regarded as the principal ingredient.¹ Its use was known to the Greeks before the process of manufacture became very familiar, for Theophrastus writes, "and if glass too is made from vitreous earth, as some say, this also takes place by compression."² The nature of the sand determined the manufacturing centers and the kind of glass produced. The most noted source of supply was the sand of the Belus river³ (modern Nahr

¹ Plin. N. H. 36, 200: *accipit harenas, ex quibus aliubi vitrum . . . fundit.* Galen, 12, 185: *κατὰ δὲ τὸν αὐτὸν τρόπον ἡ (γῆ) τὸν οὐλὸν ἔχουσκα ψάρηιος ἔστιν, ἐν φάρμῳ γὰρ τάλιστα τῆς τοιαύτης οὐρίας εὑρίσκεται ψάρηατα πολλάκις μικρά. καὶ ὅσοι τούτων ἐμπειροὶ θεαράρειν τὰς τοιαύτας ψάρηους γνωρίζουσιν ὅπόσον ἐξ αὐτῶν ἀθροῖσαι δύνανται τῆς οὐλοῦ... ἀλλ’ οὐκ ἐξ ἀπόστης ψάρηου τὸν χρυσὸν ἐξεχίρουσι καὶ τὴν οὐλοῦ οἱ περὶ ταῦτα ἔχοντες... διὰ τοῦτο μὲν οὖν καὶ τὸ γε πολλὰς φάρμοις χρυσοῦν καὶ οὐλοῦ ψυγήτων περιεχομένων οὐκ ἐπὶ πάσας οἱ περὶ ταῦτα δεινοὶ παραγίνονται.*

Euseb. (Patr. Gr. 24, 1142 A): *vidit enim cogitatus in sabulo vitrum. Intuere ergo quantum distat cogitatus a corpore. Quid videt oculus? sabulum: quid videt sensus? vitrum. Intueris alium et alium: ille enim videt sabulum iste autem videt vitrum, quod necdum est.* C. *ex sabulo fructum vitri.* Theodoret. (Patr. Gr. 83, 617 A): *Aen. Gaz. 552: καὶ ἡ ψάρηος διεσκέδασται καὶ τὸ λίτρον διακέχυται ἀλλ’ ἀνθρωπείᾳ τέχνη καίνην τίνα καὶ διαψυκῆ τὸν οὐλον ἐπενόησε.* Excerpta ex commentar. Alexandri et Olympiodori on lib. 4 (Ideler, 29): *τὴν κενθαῖς δέ φασι καὶ πυλὸν καὶ γῆν οὐλὸν, τὴν ἔχουσαν ἐν αὐτῇ οὐγρότητος, ὅποτα ἔστιν, τοξοῖς οὐδεος γίνεται.*

² Theophr. de Lapid. 49: *εἰ δέ καὶ δεῖλος ἐν τῆς οὐλίτιδος ὡς τίνες φασι, καὶ αὕτη πυκνώσει γίνεται.*

³ Plin. N.H. 5, 75: *iuxta Getta, Geba rivas Pacida sive Belus, vitri fertiles harenas parvo litore miscens.* Id. 36, 90 ff.: *pars Syriae, quae Phoenice vocatur, finitima Iudeaeae intra montis Carmeli radices paludem habet, quae vocatur Candebia, ex ea creditur nasci Belus amnis quinque milium passuum spatio in mare perfluens iuxta Ptolemaidem coloniam. latus hic cursu, insaluber potu, sed caerimoniis sacer, limosus, vado profundus, non nisi refuso mari*

Na^omēn)¹ in southern Phoenicia. Pliny says "the part of Syria, which is called Phoenicia, bordering upon Judaea, has within the spurs of Mt. Carmel a swamp, which is called Candebia. It is thought that the Belus river rises from this and after a distance of five miles flows into the sea near the colony of Ptolemais (Ake) . . . The length of the shore is not more than half a mile and this was sufficient for making glass during many centuries." Besides this sand, according to Strabo, "there are those who say that the Sidonians also have vitreous sand suitable for melting."² The glass workers of Alexandria considered their costly, colored glass dependent upon the sands of Egypt.³ Pliny mentions the white sand of the Volturnus between Cumae and Litternum as suitable for making glass.⁴ Gaul and Spain also seem to have had their sources of

harenas fatetur; fluctibus enim volutatae nitescunt detritis sordibus. tunc et marino creduntur adstringi morsu, non prius utiles. quingentorum est passuum non amplius litoris spatium, idque tantum multa per saecula gignendo fuit vitro (compare Isid. Etym. 16, 16, 1). Tac. Hist. 5, 7: et Belius amnis Iudaico mari inlabitur circa cuius os lectae harenae admixto nitro in vitrum excoquuntur. Joseph. Bell. Iud. 2, 10, 2: κυκλοτερής μὲν γάρ ἐστιν καὶ κοῦλος, ἀναδύσων δὲ τὴν θείνην φάρμον, μὲν ὅταν ἐκκενώσῃ πολλὰ πλοτα προσσχόντα, πάλιν ἀντιπληροῦται τὸ χωρίον, κατασυρόντων μὲν ὥσπερ ἐπίτησες τότε τῶν ἀνέρων εἰς αὐτὸ τὴν ἔξωθεν ἀργὸν φάρμον, τοῦ δὲ κετάλλου πάσαν εὐθέως κεταρβάλλοντος εἰς θέλον. θαυμασίωτερον δὲ τούτου μοι δοκεῖ τὸ τὴν ὑπερχυθεῖσαν θέλον ἐκ τοῦ τόπου πάλιν φάρμον γίνεσθαι εἰκαίαν.

¹ Benzinger, P. W., S.v. Belos.

Strab. 16, 758: μετεργέν δὲ τῆς Ἀκης καὶ τύρου θινώδης αἰγυκλός ἐστιν δὲ φέρων τὴν σαλττίν ἄρμον ἐνταῦθα μὲν οὖν φασὶ μη χετοθαι, κομισθεῖσαν εἰς σίδονα δὲ τὴν χωρεῖαν δέχεσθαι. Τίνες δὲ καὶ τοῖς σιδονίοις εἶναι τὴν σαλττίν φάρμον ἐπιτησίαν εἰς χύτιν, οἱ δὲ πάσαν παρταχοῦ χετοθαί φασιν. (Compare Eustath. Comm. on Dionys. Periegetes, 912).

² Strab. 16, 758: ἥκουσα δ' ἐν τῇ Ἀλεξανδρείᾳ παρὰ τῶν Σαλουργῶν, εἶναι τινες καὶ κατ' Αἴγυπτον σαλττίν γῆν, δις χωρὶς οὐχ οὔτον τε τὰς πολυχρόνους καὶ πολυτελεῖς κατασκευὰς ἀποτελεσθῆναι, καθάπερ καὶ ἄλλοις ἄλλων γῆγράτων δεῖν,

³ Plin. N.H. 36, 194: iam vero et in Volturno amne Italiae harena alba nascens sex milium passuum litore inter Cumas atque Litternum, qua mollissima est, pila molave teritur.

supply.¹ But the use of crystal in India to produce an unparalleled quality of glass² is doubtful. Crystal was more valuable than glass, and, as Friedrich observes, it is not probable that it was destroyed to make a less valuable product.³ However, the broken pieces, chips and fragments might have been so used. Yet even so, or if a kind of quartz were meant by crystal, it would still be uncertain whether in antiquity glass was ever manufactured in India.⁴ The alkali most frequently mentioned is nitrum,⁵ a natural soda of some kind⁶ found plentifully in Egypt.⁷ The ashes of certain plants and woods were also used. A scholiast on Aristophanes' Clouds says, "we call hyalos that which has just been burned from a certain herb and melted by fire for the preparation of certain vessels."⁸ Theophilus recommends the use of the

¹ Id. 36, 194: *iam vero et per Gallias Hispaniasque simili modo harena temperatur.*

² Id. 36, 192. *auctores sunt in India et crystallo fracta fieri et ob id nullum comparari Indico.*

³ Friedrich (Rhein. Jahrb. 74, 173) suggests a clear quartz in place of crystal.

⁴ Wallace-Dunlop, Glass in the Old World, 106: "Sir G. Birdwood has suggested that when Pliny speaks of Indian glass . . . he probably meant Chinese; a confusion very likely to be made at that time in Rome, especially as the Chinese still use quartz rock at the present day for making glass, and Royle tells us enamellers in India still use cakes of glass imported from China." Kisa, Das Glas im Altert. 1, 105 ff.

⁵ Plin. N.H. 36, 191 ff.; Tac. Hist. 5, 7; Aen. Gaz. 552; Isid. Etym. 16, 16, 2 ff.

⁶ Blümner, Tech. u. Term. 4, 388.

⁷ Plin. 31, 110.

⁸ Schol. on Aristoph. Nub. 768: *αλλως οὐδον ἄπεις περιπτίως τὸ ἐκ ποτάρνης τίνος κεκαυρέονται οὐδὲ πυρὸς τυπόμενον εἰς κατασκευὴν ἀγγείων τίνων λέγοντες.* Salmas. Plin. Exercit. 771 a, G ff.: *ex herba vitrum confidere inventum tunc locorum in Graecia tradit. quod hodie sit. ex cineribus filicis exustae admixta, quam soldam vocant, conflatur vitrum sed vilius. filicarios calices vulgo vocamus. at herba illa de qua loquitur interpres Aristoph. quae exurebatur ad vitra conflanda, est herba kali. sic Arabes vocant*

ashes of beech-wood.¹ Heraclius also mentions the use of ashes in the preparation of glass.² There is almost no reference to lime in connection with glass, but probably Pliny includes it when he speaks of the use of shells.³ Besides the necessary ingredients other materials were introduced for the purpose of coloring the glass. Although there are repeated references to colored glass and the imitation of gems, there is little indication among earlier writers what materials were used to produce the different colors. The use of dark substances, such as the Alabandicus stone,⁴ might possibly produce a dark glass. However, the nature of the stone is a matter of dispute.⁵ Among other things Pliny lists magnetic oxide of iron, which would very probably give a dark color, and copper, which was definitely used for coloring.⁶ In late writers,

¹ Theophil. Divers. Art. Sched. 2, 1: si sederit animo tuo ut vitrum componas, primum incide ligna faginea multa et exsicca ea. deinde combure ea pariter in loco mundo, et ciueres diligenter colligens, cave ne quicquam terrae vel lapidis commisceas.

² Heracl. op. cit. 3, 7: vitrum efficitur de cineribus, id est, de filicis cinere, et de faina, id est, de parvulis arboribus quae sunt vel crescunt in sylvis. Accipitur autem filix ante Festum S. Johannes Baptiste, et optime siccatur, deinde ad ignem mittitur et fit cinis. Similiter et faina efficietur cinis per ignem. Accipies itaque duas partes de filice, et tertiam partem de faina, et simul misces. Heraclius is quoted after Theophilus in this instance because the third book, unlike the other two books of Heraclius, is later than Theophilus (See Heracl. ed. Ilg., p. V).

³ Plin. N.H. 36, 192, note 6 below.

⁴ Id. 36, 62: e diverso niger est Alabandicus terrae suae nomine, quamquam et Miletii nascens, ad purpuram tamen magis aspectu declinante. idem liquatur igni funditurque ad usum vitri.

⁵ Nies, P. W. s.v. Alabandicus.

⁶ Plin. 36, 192: mox, ut est ingeniosa sollertia, non fuit contenta nitrum miscuisse; coeptus addi et magnes lapis, quoniam in se liquorem vitri quoque ut ferrum trahere creditur. simili modo et calculi splendentes multifariam coepti uri, dein conchae ac fossiles harenae . . . levibus autem aridisque lignis coquitur addito cypro ac nitro, maxime Aegyptio. Compare Isid. Etym. 16, 16, 3. On the employment of copper for coloring glass. Theophr. de Lapid. 49: ισιωτάτη ή τῷ χαλκῷ τύγρυπέν. πρὸς γὰρ τῷ τύκεσθαι καὶ

such as Heraclius and Theophilus, detailed accounts of the coloring of glass may be found.¹

For mending broken glass either chalk and white of egg,² or sulphur³ were employed.

τίγρυροι καὶ σύραμιν ἔχει περιττὸν εἴστε τῷ κάλλει τῆς χρόας πολεῖτε σιαφοράν.

¹ Heracl. op. cit. 2, 18 ff.; 3, 1 ff. Theophil. op. cit. 2, 7, 8, 12, 16. In the final form of my study these works will be translated in an appendix.

² Plin. 29, 51: et, ne quid desit ovorum gratiae, candidum ex iis admixtum calci vivae glutinat vitri fragmenta.

³ Plin. 36, 199: vitrum sulpuri concoctum feruminatur in lapidem. Iuv. 5, 48: calicem . . quassatum et rupto poscentem sulpura vitro. Scholia Vetera (Iuv. Sat. ed. Heinrich, 1839) on 5, 48: quassatum et rupto: ut solent sulfure calices fractos sive calvariolas componere. sulfura: quia hoc solent vitrum solidare, id est, maltare . There is also a possibility that the cup is so worthless that it is ready to be traded for sulphur, for there seems to have been a practice of trading broken glass for sulphur. Cf. Mart. 1, 41: transtiberinus ambulator, qui pallentia sulphurata fractis permutat vitreis. Stat. Silv. 1, 6, 74: hic plebs scenica quique comminutis permutant vitreis gregale sulphur.

C. Methods

The art of making glass, the hyalourgikē technē,¹ included much more than simply melting together a silicate and an alkali. The sand was made as fine as possible and then mixed with three parts of soda.² Theophilus gives the proportion of one part of sand to two of ashes.³ After the ingredients had been thoroughly mixed, they were put into a glass oven. Unfortunately ancient writers have left little information concerning the glass oven, the Greek kaminos hyelourgikē,⁴ the Latin fornax.⁵ Dioscorides says that "the soot

¹ David. Proleg. et in Porphyr. Isogogen. 20, 11 ff.: οῖον ὡς ἐπὶ τῆς ψαλουργικῆς ἔαντι γὰρ εἴπωρεν δτι ψαλουργικῆ ἔστι τέχνη περὶ ψαλον καταταγινορένη. Τελεῖος ἔστιν ὄρος. εἰ τι μὲν γὰρ ψαλουργικῆ ἔστι, τοῦτο τέχνη περὶ ψαλον καταταγινορένη, καὶ εἰ τι περὶ ψαλον. καταταγινορένη, τοῦτο τέχνη ἔστιν ψαλουργικῆ. οὐ γὰρ γὰρ ψαλουργικῆ μόνη ὑποκεῖται δ ψαλον.

Nicephorus Bleimmaida (Patr. Gr. 142, 697): ψαλουργικῆ ἔτι τέχνη καταταγινορένη περὶ τὸν ψαλον.

² Plin. N.H. 36, 194: pilla molave teritur. dein miscetur III partibus nitri pondere vel mensura. One would naturally expect that three parts equalled three-fourths (Harper's Lex. s.v. pars, II, G), but this proportion of sand and soda although it can be fused, does not make glass (See Gelsthrap and Parkinson, The Limits of Proportions of Soda-Lime Glasses in Tr. Am. Cer. Soc. 16, 1914, 109 ff.). Froehner, La Verrerie, 27, takes this passage to mean three parts of soda to nine of sand, basing his opinion on the theory that the duodecimal system was used. This sounds extremely attractive in view of the fact that it makes a possible proportion of sand and alkali, but in no place have I been able to find pars used as one twelfth.

³ Theopil. op. cit. 2, 4: deinde tollens duas partes cinerum de quibus supra diximus, et tertiam sabuli diligenter de terra et lapidibus purgati, quod de aqua tuleris, commisce in loco mundo.

⁴ Geopon. 20, 16: Κριοῦ τὸ μόριον βαλῶν εἰς ὄροφιον ὠμόν, καὶ ἄλλο ὄροφιον ἐπικελύφας πίδησον, ὥστε μὴ ἔχειν ἀνάπνεον μηδαρόθεν. καὶ δος εἰς κάρινον ψαλουργικῆν ὄπτηθῆται ἀπὸ πρωτὶ ἐώς ἐσπέρας, καὶ εὐήσεις αὐτὸν μαλακὸν γεγονός ὡς τυφόν.

⁵ Plin. N.H. 36, 193.

which the painters use is taken from the places where glass is made.¹ The poor people seem to have gone to the glass-houses to get warm.² A fantastic story is told of a boy who was thrown into an oven by a Jew, but miraculously rescued.³ None of these references, however, give any idea of the construction of the oven. But in the works of Theophilus⁴ and Heraclius⁵ there are elaborate descriptions of the different ovens for cooking, cooling, and reheating. The kind of fuel used was of great importance for the production of the proper degree of heat. Pliny says that the wood should be light and dry.⁶ Both tamarisk⁷ and papyrus⁸ were suitable for the purpose.

As soon as the mixture of sand and soda began to get hot, it was stirred so that it would not liquify and congeal immediately. There were windows in the glass-ovens, through which the workmen could carry on such operations.¹⁰ But as soon as it did liquify,

¹ Diosc. 5, 181: ἀσβόλη, ἣν οἱ ζωγράφοι χρῶνται, λαρβάνεται μὲν ἐκ τῶν οὐελουργείων. Compare Paul. Aeg. 106^v, 10.

² Leont. Vita S. Symeon. Sali (Patr. Gr. 93, 1736 D): οὐδὲ πάτιν ἄπαξ καθύπερος μετὰ ἀστελφῶν, καὶ θερμανότερος πλησίον τοῦ καρπίνιου τοῦ οὐελεφού.

³ Michael Glycas (Script. Hist. Byz. 27, 506); Georg. Cedremus (Script. Hist. Byz. 34, 687).

⁴ Divers. Art. Sched. 2, 1, 2, 3, 22.

⁵ De Color. 3, 7. Froehner, op. cit. 27; Blümner, op. cit. 4, 389.

⁶ Plin. N.H. 36, 193.

⁷ Plut. Quaest. Conv. 3, 19, 3, 658 D: πρὸς δὲ τὸν τοῦ οὐελού ἄλαξιν καὶ τύπωσιν εὐάρμοστον εἴρει δοκεῖ τὸ μυρίκινον. Macrob. 16, 23: qui vitro soluendo formandoque curant, de arbore, cui myricae nomen est (igne utuntur).

⁸ Cass. Felix. de Med. 20: papyrus vitriariorum carnosum, id est quod non fuerit fragile vel flacidum. Olympiod. on Arist. Meteor. 2, 228: δθει πολλὴ φροτής παρὰ τοῖς οὐελέψεις τοῦ τινάσσειν τὸν πάπυρον, i.e., so that a salamander would not fall in the fire and put it out.

⁹ Theophil. op. cit. 2, 4.

¹⁰ Heracl. op. cit. 3, 7.

it was transferred to other ovens where it was allowed to form a mass called ammonitrum, i.e., sand-natron. This was reheated until there resulted a pure, transparent glass,¹ or colored glass, in case some material or materials had been added for that purpose.² Then after the proper tempering, the glass was ready for fashioning into objects.³ At first everything was formed by hand, and the discovery of blowing glass must have brought a great change both in the number of workmen required and in the number and variety of vessels produced.⁴ In some instances the glass was worked upon a lathe, in others it was elaborately carved like silver.⁵

¹ Plin. N.H. 36, 194: ac liquata in alias fornaces transfunditur ibi fit massa, quae vocatur hammonitrum, atque haec recoquitur et fit vitrum purum ac massa vitri candidi.

² Id. 36, 193: continuis fornacibus ut aes liquatur, massaeque fiunt colore pingui nigricantes. Theophilus, Divers. Art. Sched. 2, 7 ff.

³ Mesomedes (Anth. Pal. 16, 323) quoted on page 82. Theodoretus, de Provid. 4, 39 (Patr. Gr. 83, 617 A ff.): πόθεν ἔμαθε φύσιν ὑέλου; τίς αὐτὸν τῆς φάρμακον τὴν σιαφορὰν ἐπάίδευσε; τίς αὐτὸν ἐδίδαξε τὴν τοιάνδε φάρμακον τῷ πυρὶ παραδίδοθαι, καὶ ὅπως, καὶ ἐπὶ πόσον; καὶ τὴν συνεχῆ μὲν χωρίζειν, τὴν χωριστὴν δὲ εἰς συνεχὲς ἔχωριστον μεταβάλλειν; πῶς ἔγρω σιαττάττειν ἐκ ταύτης, πυρὶ καὶ πνεύματι συνεργύῳ κεχρητέος, ἐκ πυρμάτων εἴδη μυρία, φίλας, καὶ κύλικας, καὶ βοτβύλους, καὶ ἀρφορίσκους, καὶ ἐπιπλα, καὶ ἔτερα σικεύη πρὸς πάσαν χρείαν βρωτῶν ἐπιτίθεια;

⁴ Sen. Epist. 90, 31: cuperem Posidonio aliquem vitrearium ostendere qui spiritu vitrum in habitus plurimos format, qui vix diligentem manu effingerentur. Vopiscus, Saturninus, 8, 6: alii vitrum conflant. Pallad. Schol. on Hippocr. 2, 222: ὁ γὰρ Σάλωψ ἄρα τῷ φυσῆν καὶ πόρον ποιεῖ τίνα καὶ σχῆτα.

⁵ Plin. N.H. 36, 193: ex massis rursus funditur in officinis tinguiturque, et aliud flatu figuratur, aliud torno teritur, aliud argenti modo caelatur. Apul. Met. 2, 19: hic vitrum fabre sigillatum.

D. Kinds of Glass

There is no definite reference in Greek literature to the earliest form of glass-making, the art of glazing. However, the silver color given to a variety of the pottery of Naucratis may have been produced in that way.¹ Glass-paste is mentioned in Homer, as has been discussed under kyanos.²

The chief characteristic of hyalos, as has been shown, was transparency. The glass most highly prized was that which most closely resembled crystal.³ The similarity probably led to colorless glass sometimes being called simply krystallos in Greek⁴ and crystallum⁵ in Latin, while objects made of it would be designated as crystallina.⁶ In most instances it is impossible to determine

¹ Athen. 9, 480 D: διάφοροι δὲ κύλικες γίνονται καὶ ἐν τῇ τοῦ συρρικτοῦ φράντι Αθηναίου πατρίδι Ναυκράτει. εἰσὶ γὰρ φιλόδεις κέν, οὐ κατὰ τόργον δι' ἀλλ' ὥσπερ σάκτουλη πεποιημέναι, καὶ ἔχουσιν ὡτα τέσσαρα, πυθμένα εἰς πλάτος ἐκτεταρένον, καὶ βάπτονται εἰς τὸ δοκεῖν ἀργυραῖ.

See Blümner, Tech. u. Term. 2, 97.

² See above, p. 8ff.

³ Plin. 36, 198: maximus tamen honos in candido tralucentibus, quam proxima crystalli similitudine.

⁴ See above, p. 58ff.

⁵ Mart. 9, 22: nec labris nisi magna meis crystalla terantur. 10, 66: quis potius cyathos aut quis crystalla tenebit. 12, 74: dum tibi niliacus portat crystalla cataplus, accipe de circo pocula Flaminio.

⁶ Sen. de Benef. 7, 9, 3: video istic crystallina, quorum accendit fragilitas pretium. de Ira, 3, 40, 2: fregerat unus ex servis eius crystallinum. Mart. 1, 53: sic Arretinae violent crystallina testae. 9, 59: et turbata brevi questus crystallina vitro. 14, 111: Crystallina- Frangere dum metuis, franges crystallina peccant; securae nimium sollicitaeque manus. Iuv. Sat. 6, 155 ff.: grandia tolluntur crystallina, maxima rursus myrrhina. Theonas, Epist. 6 (Patr. Gr. 10, 1572 D): simili modo ille agat, cuius fidei credita sunt vasa argentea, aurea, crystallina, vel murrhina, escaria vel potoria.

whether glass or crystal is meant, but especially among the Roman poets cups of crystallum are mentioned very frequently, while we know that crystal was rare and, as far as I am aware, no vessel of it has come down, although numerous wonderfully wrought glass cups and vases have been preserved. The fact that some of the vessels are brought from Egypt, the greatest glass manufacturing center, makes it seem all the more probable that crystallum was used for glass and crystallina for objects made of glass.

Nearly every kind of gem was imitated in colored glass.¹ Very likely glass is sometimes understood by the name of a particular gem² or simply by the word gem itself.³ Glass of different colors, the Millefiori or glass mosaic, was called morria in Greek, murra in Latin.⁴ Obsidian, the black, natural volcanic glass, is classed with glass by Pliny.⁵

¹ Plin. N.H. 35, 48: admixtis vitreis gemmis. 36, 198: fit et album et murrina aut hyacinthos sappirosque imitatum et omnibus aliis coloribus. Isidor. Orig. 16, 3: tinguitur etiam multis modis, ita ut iacinthos sapphirosque et virides imitetur et onyches vel aliarum gemmarum colores.

² Hdt. 2, 44: ἐν αὐτῷ ἔτραν στῆλαι σύο, ἢ τὸν χρυσοῦ ἀπέφθου, οὐ δὲ τραπάγδου λίθου λάρποντος τὰς ρύκτας μέγαθος. See Rawlinson, Hdt. 2, 70, 8. Mart. 10, 49: cum potes amethystinos trientes et nigro madeas Opimiano.

³ Vergil, Georg. 2, 506: hic petit excidiis urbem miserosque penatis, ut gemma bibat et Sarrano dormiat ostro. Mart. 11, 11: te potare decet gemma. 12, 40: gemma vis ludere, vincor. 14, 20: Calculi-Insidiosorum si ludis bella latronum, gemmeus iste tibi miles et hostis erit. 14, 94: nostra neque ardenti gemma feritur aqua.

⁴ See above, page 62 ff.

⁵ N.H. 36, 196 ff.: in genere vitri et obsiana numerantur ad similitudinem lapiis, quem in Aethiopia invenit Obsius, nigerrimi coloris, aliquando et tralucidi, crassiore visu atque in speculis parietum pro imagine umbras reddente. gemmas multi ex eo faciunt; vidimus et solidas imagines divi Augusti capaci materia huius crassitudinis, dicavitque ipse pro miraculo in templo Concordiae obsianos IIII elephantes. remisit et Tiberius Caesar Heliopalitarum

Aside from the different kinds of glass, there are glass vessels which have special names depending upon their style. Pliny says that there was a variety of glass goblet called petrotos.¹ Probably the alassontes,² cups of changeable color, from Egypt were of opalescent glass.³ Toreumata, as used by Martial,⁴ seem to have been cups of glass carved in relief, probably like the Portland vase and Naple's amphora, although those to which he refers are not always of superior workmanship.⁵ The diatreta mentioned also by Martial⁶ are shown by Ulpian in the Digest⁷ to have been especially fragile. Such delicate work required specialized workmen, the diatretarii.⁸ With the present evidence it is impossible to prove

caerimoniis repertam in hereditate Sei eius, qui praefuerat Aegypto, obsianam imaginem Menelai, ex qua apparet antiquior materiae origo, nunc vitri similitudine interpolata. Xenocrates obsianum lapidem in India et in Samnio Italiae et ad oceanum in Hispania tradit nasci. fit et tincturae genere obsianum ad escaria vasa et totum rubens vitrum atque non tralucens, haematinum appellatum.

¹N.H. 36, 195: sed quid refert, Neronis principatu reperta vitri arte, quae modicos calices duos, quos appellabant petrotos, H S VI venderet?

²Vopisc. Saturn. 8, 10: calices tibi alassontes versicolores transmisi.

³Becker-Göll, Gallus, 2, 382; Froehner, La Verrerie, 46.

⁴Mart. 11, 11: tolle, puer, calices tepidique toreumata Nili. 12, 74: nullum sollicitant naec, Flacce, toreumata furens, et nimium calidis non vitiantur aquis. 14, 94: nos sumus audacis plebeia toreumata vitri. Cf. Clem. Alex. Paedag. 2, 3, 35: *ναι τορευτῶν περίεργος ἐφ' εὐλόγῳ κεροδοξίᾳ εἰς θραύσιν τέχνης ἐτοιμοτέρᾳ δεσμέναις.*

⁵Blümner, Tech. u. Term. 4, 404; Kisa, Das Glas, 2, 590.

⁶12, 70: O quantum diatreta valent et quinque comati.

⁷Dig. IX, 2, 27, 29: si calicem diatretum faciendum dedisti, si quidem imperitia fregit, damni iniuria tenebitur: si vero non imperitia fregit, sed rimas habebat vitiosas, potest esse excusatus.

⁸Cod. Theod. 13, 4, 2. Cod. Just. 10, 66, 1.

that the diatreta were of glass, but usually the name is thought to refer to the network vessels such as the vases in Cologne¹, which Kisa, however, regards as simply one form of diatreta.²

The use of glass vessels decorated with gold is mentioned by Athenaeus³ in connection with the banquet of Ptolemy Philadelphus. In the Church of Sancta Sophia the gold colored glass used to cover the walls and ceiling was probably in the form of mosaic so common in the early churches.⁴ Many objects have been found, especially in the catacombs, with designs in gold between two layers of transparent glass. The method of making these is fully described by Theophilus.⁵

¹ Blümner, Tech. u. Term. 4, 400 ff.

² Kisa, Das Glas, 2, 624 ff.

³ 5, 199 F: καὶ κυλικεῖα σύο καὶ ἑάλινα σιάχρυσα σύο.

⁴ Anon., Διηγησις περὶ τῆς Ἁγίας Σοφίας (Script. Orig. Const. 1, 15 (93, 6 ff.): ποὺς δὲ ὄρόφους πάντας... κατεχρύσωσι ἐξ ἑλίκου χρυσοῦ λερπροτά του.

⁵ Theoph. 2, 13: De vitreis scyphis, quos Graeci auro et argento decorant. Graeci vero faciunt ex eisdem saphireis lapidibus pretiosos scyphos ad potandum, decorantes eos auro hoc modo. Accipientes auri petulam, de qua superius diximus, formant ex ea effigies hominum, aut avium, sive bestiarum, vel foliorum, et ponunt eas cum aqua super scyphum in quocumque loco voluerint; et haec petula debet aliquantulum spissior esse. Deinde accipiunt vitrum clarissimum, velut crystallum, quod ipsi componunt, quodque mox, ut senserit colorem ignis, solvit, et terunt diligenter super lapidem porphiriticum (porphireticum M) cum aqua, ponentes cum pincello tenuissime super petulam per omnia, et cum siccatum fuerit, mittunt in furnum, in quo (ubi M) fenestrae vitrum pictum coquuntur, de quo postea dicemus, supponentes ignem et ligna faginea in fumo omnino siccata. Cumque viderint flammarum scyphum tandiu pertransire donec modicum ruborem trahat, statim ejicientes ligna, obstruunt furnum, donec per se frigescat; et aurum nunquam separabitur.

In the ^{or-on} lexical¹ the Thērikleios is defined as a glass cup. Athenaeus gives a very detailed account of this cup classifying it as a form of the kylix,² but he says there was also another kind called the Thērikleios krater.³ According to him the cup received its name from Thericles, a Corinthian of the time of Aristophanes, originally a potter, who was said to be the first maker of this kind of cup.⁴ Since Thēricleios seems to designate a particular form of cup whether of clay,⁵ wood,⁶ gold,⁷ or glass,⁸ it will be treated at a later time among the forms of glass vessels in a chapter on the uses of glass.

¹ Cyrillos, gloss (Hesych. ed. Schmidt, 4, 341); Photius: Θηρίκλειον· ποτήριον σέλινον. Bachmann, Anecd. Gr. 1, 256, 17; Suidas: Θηρίκλειον· ποτήριον σάλινον. Etym. Magn. 451, 27: Θηρίκλειον κύλικα· ποτήριον σέλινον, τὸ τοῦ θηρικλέους ποτήριον. Zonar. Lex. 1043: Θηρίκλειον· ποτήριον σέλινον.

² Athen. 11, 470 E: Θηρίκλειος· ἡ κύλιξ αὕτη ἐγκάθηται περὶ τὰς λαγόρας ἵκανως ραθυοφέρνη ὥστα τε ἔχει βραχέα ὡς κύλιξ οὐσα, κτλ.

³ Athen. 11, 472 A: καλεῖται σέ τις καὶ Θηρίκλειος κρατήρ.

⁴ Athen. 11, 470 F: κατασκευάσαι δὲ λέγεται τὰν κύλικα ταύτην Θηρικλᾶς ὁ Κορίνθιος κεραμεύς, ἀφ' οὗ καὶ τούνορα ἔχει, γεγονὼς τοῖς χρόνοις κατὰ τὸν κωρικὸν Ἀριστοφάνη.

⁵ Athen. 11, 471 D: καὶ Εὔβουλος ἐν μὲν Δόλωνι... καθαρώτερον γὰρ τὸν κέραφον εἰργασθόντινον Θηρικλᾶς τὰς κύλικας, ηνίκαντὸν νέος. Id. 11, 472 D: Θεόφιλος δὲ ἐν Βοιωτίᾳ τετρακότυλον δὲ κύλικα κεραφέαν τινὰ τῶν θηρικλείων, κτλ.

⁶ Theophr. Hist. Plant. 5, 3, 2: μέλαν δὲ σφόδρα καὶ πυκνὸν τὸ τῆς τερρίνθου· περὶ γοῦν Συρίαν τελάντερον φασι εἶναι τῆς ἐρένου· καὶ ἐκ τούτου γὰρ καὶ τὰς λαβὰς τῶν ἐγχειρίδεων τοιεῖσθαι, τορνεύεσθαι, σὲ ἐξ αὐτῶν καὶ κύλικας θηρικλείους, ὥστε μηδένα ὡρ διαγνῶνται πρὸς τὰς κεραμέας.

⁷ Athen. 11, 472 C: Πολέρων δὲ ἐν πρώτω περὶ τῆς Ἀλίνηοις Ἀκροπολεως οὐδετέρως ὠνόρκεσεν εἰπων· τὰ χρυσᾶ θηρικλεῖα ὑπόσυλα Νεόξυλα Νεοπτόλεμος ἀνέθηκεν·

⁸ See above, note 1.

As glassmaking became a more developed art, the fragility of the substance must have been felt as a great disadvantage. There is a story told of a workman who invented a flexible glass, but was beheaded by Tiberius so that this secret should not become known and cause the precious metals to depreciate in value.¹ Since Pliny, however, who lived during the reign of Tiberius and who was besides not unduly sceptical, plainly disbelieved the account, ("told with more frequency than truth" is his expression), it may be dismissed as a bit of malicious fiction.

¹ Petron. 51: *fuit tamen faber qui fecit phialam vitream, quae non frangebatur. admissus ergo Caesarem est cum suo munere, deinde fecit reporrigere Caesarem et illam in pavimentum proiecit. Caesar non pote validius quam expavit. at ille sustulit phialam de terra; collisa erat tamquam vasum aeneum; deinde martiolum de sinu protulit et phialam otio belle correxit. hoc facto putabat se solium Jovis tenere, utique postquam Caesar illi dixit: "numquam aliis scit hanc conditaram vitreorum?" vide modo. postquam negavit, iussit illum Caesar decollari: quia enim, si scitum esset, aurum pro luto haberemus.*

Plin. N.H. 36, 195: *ferunt Tiberio principe excogitato vitri temperamento, ut flexible esset, totam officinam artificis eius abolitam, ne aeris, argenti, auri metallis pretia detraherentur, eaque fama crebrior diu quam certior fuit.*

Dio Cassius, 57, 21, 7: *μετὰ δὲ ταῦτα προσελθόντος οἱ αὐτοῦ καὶ οἰκετείαρ πολουρένου, καὶ τούτῳ ποτήριόν τι δαχούν καταραθόντος τε ἐξεπίτηδες καὶ ἀθραυστον παραχρῆμα ἀποφῆναντος, ὡς καὶ συγγράψης σὰ τοῦτο τευχορένου, καὶ ἀπέκτεινεν αὐτόν.*

Isid. Orig. 16, 16, 6: *ferunt autem sub Tiberio Caesare quendam artificem excogitasse vitri temperamentum, ut flexible esset et ductile. qui dum admissus fuisset ad Caesarem, porrexit phialam Caesari, quam ille indignatus in pavimentum proiecit. artifex autem sustulit phialam de pavimento, quae complicaverat se tamquam vas aeneum; deinde marculum de sinu protulit et phialam correxit. hoc facto Caesar dixit artifici: 'Numquid aliis scit hanc conditaram vitrorum?' postquam ille iurans negavit alterum hoc scire, iussit illum Caesar decollari, ne dum hoc cognitum fieret, aurum pro luto haberetur et omnium metallorum pretia abstraherentur; et reversa, quia si vasa vitrea non frangeretur, melius essent quam aurum et argentum.*

E. Glass Workers

Strabo¹ is the first to mention the hyalourgos, and it was from the glass workers of Alexandria that he received his information about Egyptian glass. One of the first vitrearii mentioned in Latin literature is the fabulous inventor of unbreakable glass.² In late Greek writers several stories are told of individual workmen. Michael Glycas and Georgius Cedrenus tell of a Hebrew hyelepsos in the reign of Justin who was executed for throwing his son into the glass furnace because he partook of Christian bread.³ In the next century the conversion of a Jewish glass worker is related by Leontius. As the people sat about the furnace warming themselves, a dispute arose between the Jew and the Christians. Saint Symeon Salus, as the story goes, began miraculously to cause the breaking of the vessels which were about the room and continued

¹ Strabo, 16, 758.

² See above, page 79.

³ Michael Glycas, Annal. 4 (Script. Hist. Byz. 27, 506): ΚΚΤ' ἘΚΕΤΟΝ ΚΚΙΡΟῦ ἀκεφάνη καὶ διελοψός Ιουδαῖος ὁ τὸ παιδίον αὐτοῦ διὰ τὸ ἐγκαθῆναι χριστιανοῖς παιδίοις καὶ φρυγεῖν ἀπὸ τῆς μυστικῆς τραπέζης βαλὼν εἰς τὸν κάρπιον, εἰ καὶ οὐκ ἐφλέχθη τῆς θεοτόκου φυλαξάσης αὐτό, καθά διὰ τὸ παιδίον διεβεβαίουτο. Ταύτη τοι καὶ τοῦ τοιούτου θαύματος διὰ τοῦ πατριάρχου Μηνᾶ γυμνισθέντος τῷ βασιλέτ, μετακαλεῖται δ' Ιουδαῖος. Παλλὰ τούτων παρανεθεῖσι καὶ μη πειθθεῖσι τῆς οἰκείας ἀποστερεῖται γωνῆς ὡς φορεὺς τοῦ ἴδιου παιδός.

Georgius Cedrenus, Hist. Compend. (Script. Hist. Byz. 34, 686 ff.): ἐπὶ τούτου τοῦ εὔσεβεστάτου Ἰουστίνου Ἰουδαῖος τις ἐν τῇ πόλει διελοψός παιδίον ἐκέκτητο... ὁ δὲ δόλιος ἐκέντος θύρα σφόδρα μανεῖς, μετὰ τὸ ἀριστῆσαι λαβὼν τὸ παιδίον καὶ ἀπελθὼν εἰς τὸ ἔργαστήριον αὐτοῦ ἔρριψεν αὐτὸν εἰς τὸν κάρπιον καὶ κλείσας τὸν θύραν ἀνεχώρησεν... δύον καὶ προσέταξεν αὐτὸν ἀνασκολοπισθῆναι ὡς φορέα γενότερον τοῦ ἴδιου παιδίου.

to do so until the glass worker had crossed himself.¹ Joannes Moschus mentions a workman who had been blinded by the fire.²

In inscriptions the names of a few glass workers have been preserved. Euphrasios is mentioned on a Jewish or Christian sepulchral inscription in Athens.³ In Mauretania there was a vitriarius Antas whose name occurs upon the sepulchral inscription of his little son.⁴ Julius Alexander was likewise a native of Africa, a Carthaginian citizen, who was evidently living at Lyons at the time of his death.⁵ Perhaps a glass manufacturer of Gaul had called him to that place.

There are other references in literature and the laws which give glimpses of the duties and social standing of glass

¹ Leontius (Patr. Gr. 93, 1736 D): ήν σὲ πάλιν ἄπαξ καθίτερος μετὰ ἀδελφῶν, καὶ θεραπευτήρεος πλησίον τοῦ καρνιόν του οὐδελέψοντος. ήν σὲ Σελεύκος Ἐρρατός, καὶ λέγει τοῖς πτωχοῖς παιζων, κτλ.

² Joannes Moschus, Pratum Spirituale (Patr. Gr. 87, 2932 A): οὐ πῶς γέγονας τυφλός; ἀπεκρίθη καὶ κέντρος λέγων. οὐδελέψος οὐτον τὴν τέχνην, καὶ ἐκ τοῦ πυρὸς ἐπίχυσιν ἔσχον οἱ δύο ὄφεληροι, καὶ ἐτυφλώθην.

³ I G III 3436: Κυρντεύηρον Εύφραγείου οιαλᾶ | κὲ Γενναδίας.
See above, page 43.

⁴ C I L VIII 9430: Saburrio, Antae vitriari et Paulas (=ae) f(iilius), vixit menses sex.

⁵ C I L XIII, 1,1,2000: et · memoriae · aeterne · Iuli. Alexandri natione Afri · civi Carthaginiensi · omni · optimo · opifici · artis · vitriae · qui vix · anos LXXV mensem · V · dies · XIII · sene · ulla lesione · animi cum · coiuge sua · virginia cum qua · vix sit · annis XXXVIII · ex qua creavit · filio VII et eiliam (sic) ex quibus · his omnibus · ne potes · vidite · deos supest (sic) ites · sibi · reliquit hunc tumulum · ponendum CV raverunt · Numonia · Bellia · uxsor · et · Iulius · Felix · filius · et Iulius Galonius · filius · et · Numonia · Belliosa · filia item nepote S eius Iulius · Augt?us · Iulius · Felix · Iulius Alex ? sander Iulius Galonius? Iulius Leontius Iulius Gali.... Iulius · Eonius · P/P · Cyri- et sub aso dedicaverunt.

workers in general. If papyrus were used for fuel, it was thought best for the workmen to shake the stalks so that a salamander would not fall into the fire and put it out.¹ Of a much earlier date is the epigram of Mesomedes,² which describes the making of glass and the handling of it. "The workman having quarried it, brought the glass and put in the fire the mass hard as iron, and the glass, set afire by the all-devouring flames, ran out melted like wax. And to men it was a marvel to see a trail flowing from the fire and the workman trembling lest it should fall and break; and on the points of the double forceps he put the lump." A scholiast on Hippocrates³ says that the workman by blowing produces both the opening and the shape of the vessel.

Under Constantine exemptions were granted to many artificers, including the vitrearii and diatretarii, that they might become more skilled in their art and see to the training of their sons.⁴ In the Digest⁵ there is an edict for the punishment of

¹ Olympiodorus on Arist. Meteor. 3 (Ideler, 228): ὅθεν πολλὴ φροντίς παρὰ τοῖς θελέψαις τοῦ τινάσσειν τὰν πάπυρον.

² Anth. Pal. 16, 323: τὰν θελον ἐκόριζει κόψας ἐργάτας ἀνήρι πὲ πῦρ ἔθηκε βῶλον, οὐδὲ σίδηρον εὐσθενῆ. Ιά σ' θελος, οὐδὲ κυρός, ἔφεχετο, παρφάγοισι | φλοξὶν ἐκπορουμένα | θαῦρα σ' ἦν οἰστρος προτοῦς | σόλκον ἐκ πυρὸς ἀρέοντα, | καὶ τὸ ἐργάτην τρέμοντα, | τὴν πεσὼν σιαρραγῆ. | εἰς δὲ διπτύχων ἀκρὰς | κηλέων ἔθηκε βῶλον.

Translation by W. R. Paton.

³ Palladii Schol. on Hippocr. (Dietz, 2, 222): δὲ γάρ θάλαψα ἀνατῷ φυσάν καὶ πόρον ποιεῖ τινα καὶ σχῆμα.

⁴ Cod. Theod. XIII, 4, 2: Imp. Constantinus A. ad Maximum pp. Artifices artium brevi subdito comprehensarum per singulas civitates morantes ab universis muneribus vacare praecepimus, si quidem ediscendis artibus otium sit accommodandum, quo magis cupiant et ipsi peritiores fieri et suos filios erudire. D IIII non. Aug. Feliciano et Titiano cons. [a. 337]... diatretarii ... vitriarii. This is repeated in Cod. Just. X, 66, 1, with slight variations in spelling, i.e., diatritarii V... vitrearii.

⁵ Dig. IX, 2, 27, 29.

diatretarii who through carelessness break the goblets intrusted to them, but protecting workmen who had received material containing flaws. Constantinus Harmenopulus¹ in a compendium of laws drawn up in the fourteenth century quote extracts from Julian of Ascalon, who is otherwise unknown, but he must have lived before the Arab conquest of Palestine in 636. This edict states that workers in glass and iron should not carry on their business in the city, but if that is necessary, the workshops should be in remote and sparsely populated parts of the city to prevent sickness and the destruction of property by fire.

¹ Hexabiblos, 2, 4, 19: ἐπαρχικὸν περὶ οἰκονομίας (Ἐπαρχία) καὶ σιδηρουργῶν. οἰκονομίας (σιδηρουργίας) καὶ σιδηρουργῶν τοὺς ἐργάζοντες τὰς ἀγίνας καὶ τὰς ἄκαστας, καὶ τὰ τοιαῦτα μεγάλα ὄργανα, καὶ ἀνθρακιαντο πλάστας οὐ χρὴ ἐν αὐταῖς ταῖς πόλεσι τὰ τοιαῦτα ἐργάζεσθαι· εἰ δὲ ἀγάγειν τις γένηται τούτους κατοικεῖν τὰς πόλεις καὶ τὰς τούτων ἐργασίας ἐν αὐταῖς γίνεσθαι, εἰς τοὺς ἀπωκιστρένους καὶ ἴδιαγοντας τῶν πόλεων τόπους δεῖν ταύτας ἐργάζεσθαι· πολὺς γὰρ ὁ ἀπὸ τοῦ πυρὸς πέλων κίρσυρος τοῦς οἰκητὰς καὶ τοῖς σώμασι συνεχῆς λοιρὸς γίνεται.

F. Manufacturing Centers

Natural resources greatly influenced the location of manufacturing centers. Egypt possessed both sand and nitrum, and it is, therefore, not surprising that the first certain mention of glass in Greek and in Latin is in connection with that country. Herodotus tells of the sacred crocodiles wearing earrings of glass.¹ In the Periplus of Scylax glass is designated simply as 'Egyptian stone.'² Theophrastus says that the Egyptians made an artificial kyanos,³ which has been identified with glass-paste such as that of the frieze of Tiryns.⁴ Martial speaks of the toreumata of the Nile⁵ and again of the fleet of the Nile bringing crystalla.⁶ In a letter of the Emperor Hadrian⁷ the blowing of glass is mentioned, while the alassontes referred to in the same letter were probably of glass.⁸ Under the Emperor Aurelian a tax was put on glass brought from Egypt to Rome.⁹ Even among the various kinds of darts, found chiefly among the Egyptians, those of glass also occurred.¹⁰

¹Hdt. 2, 69.

²Scyl. Peripl. 112.

³Theophr. de Lapid. 55.

⁴See above, page 8.

⁵Mart. 11, 11.

⁶Mart. 12, 74.

⁷Vopisc. Saturnin. 8 ff.

⁸See above, page 7c.

⁹Vopisc. Aurel. 45: vectigal ex Aegypto urbi Romae Aurelianus vitri chartae lini stupuae atque anabolicas species aeternas constituit.

¹⁰Paul. Aeg. Chirurgia, 348: αὐτὰ τὰ βέλη... Σάλινα... τοσαύτη γὰρ τις διαφορὰ μάλιστα παρ' Αἰγυπτίοις εὑρίσκεται.

Alexandria was one of the greatest glass manufacturing centers of antiquity. Cicero¹ is the first to mention glass that was imported from there. And it was workmen of that city who gave Strabo his information about the excellent Egyptian sand.² Athenaeus had heard that in Alexandria they imitated every possible kind of earthenware cup in glass.³ Demetrius⁴ uses Alexandrian glass. In repeating the description of burial in glass as given by Herodotus and Ctesias, Diodorus⁵ adds that there was plenty of glass for all because there was a great deal of it made in Aethiopia. Although the story itself is probably false (see above, page 20ff.), at the time of Diodorus glass from that part of the world was well known. The glass and myrrhine for export to the Berbers, mentioned in the Periplus of the Red Sea, were made at Thebes.⁶

There was also excellent sand in Phoenicia along the Belus river and according to some at Sidon likewise.⁷ In the early empire this city was already an important manufacturing center, for Pliny calls Sidon the artifex vitri,⁸ and ascribes to her the invention of the mirror⁹ (i.e., of glass). Lucian¹⁰ uses Sidonian

¹ Pro Rabir. Post. 14, 40: 'dominatus est enim,' inquit, 'Alexandriae'. . . fallaces quidem et fucosae e chartis et linteis et vitro velatae; quibus cum multae naves refertae fuissent, una non completa fuit parva.

² Strabo, 16, 758.

³ Athen. 11, 784 C: ΚΑΤΑΣΚΕΥΑΣΟΥΣ Σὲ, φησίν, οἱ ἐν Ἀλεξανδρείᾳ τὴν Σάλον μεταρρυθμίζοντες πολλάτς καὶ ποικίλας ισέασι ποτηρίων, πάντος τοῦ παρταχόθεν κατακομηκοτέρου κεράτου τὴν ισέαν τιμούστεροι.

⁴ Hieracosiphion, 271, 281.

⁵ Diod. 2, 15.

⁶ Peripl. Maris Erythr. 6.

⁷ See above, page 67. ⁸ Plin. N.H. 5, 76. ⁹ Plin. N.H. 36, 193. ¹⁰ Amores, 26: τὸ δὲ ἄλλο σῶρα μηδὲ ἀκαρῆ τριχός αὐτᾶς ἐποφυοτέρνις ἡλέκτρου, φασίν, ἡ Σιδωνίας οὐδενὶ διαφεγγέστερον ἀπαστράπτει.

glass as a standard of transparency. By Sidonian cup Athenaeus¹ might possibly mean a cup of glass,² since it was that for which the city was so noted.

Reports of the manufacture of glass in the far East are less trustworthy. Pliny praises most highly the glass of India which, he says, was made of broken crystal. However, it is extremely doubtful if glass was made in India.³ When Propertius⁴ writes of 'murrhine cups baked in Parthian ovens,' it may be no more than a poetical way of saying that they came from the near East, and, if so, the expression would indicate that the manufacture of glass had in the first century spread from Phoenicia as far as Mesopotamia.

In the time of Strabo very clear, crystal-like glass was being manufactured at Rome. This glass was very cheap in price.⁵ In the first region, which lay between the Aventine and Caelian there was a vicus vitrarius,⁶ the exact location of which is not known.⁷ It was in connection with the fine white sand of the Voltumnus that Pliny gave his description of the process of making

¹ Athen. 11, 468 C: ὅλοι δὲ τὸ ἐρ κύκλῳ τύπους ἔχον σῖον σακτύλους, καὶ τὸ ἔχον ἔξοχὰς οὖτα Σ. Σύνια ποτήρια, καὶ τὸ λεπτὸν.

² Blümner, Term. u. Tech. 4, 381, 3.

³ See above, page 68.

⁴ Prop. 4, 5, 26.

⁵ Strabo, 16, 758: Καὶ ἐν Ρώμῃ σὲ πολλὰ παρευρίσκεσθαι φασι καὶ πρὸς τὴν ἡραστῶν τῆς κατασκευῆς, καθάπερ ἐπὶ τῶν κρυσταλλφανῶν. ὅπου γε καὶ τρυβλίον χαλκοῦ πρίσασθαι καὶ ἐκπικράτιον ἔστιν.

⁶ Reg. urb. reg. 1, 3, 5 (Curios. urb. reg. 1, 2, 5) in Urlichs, Cod. urb. Rom. top: Regio I. Porta Capena. . . vicum vitrarium.

⁷ Jordan, Topogr. d. St. Rom. 1, 3, 219.

glass.¹ In Puteoli there was a clivus vitriarius,² which would lead one to think that glass was made there. The name of the town Vitricium,³ modern Verres,⁴ may have nothing to do with vitrum, but it is conceivable that as the knowledge of glass making spread to the provinces, a factory was established in northern Italy and the town received its name from its principal industry.

In the provinces of Gaul and Spain, according to Pliny,⁵ glass was made in the same way as in the vicinity of Cumae. But Strabo does not speak very highly of the glass vessels which the Britons imported from Gaul.⁶ One of the particular places where glass was made was Lugdunum. A sepulchral inscription has been found here of a glass worker from Carthage.⁷ As has been mentioned, others were found in Mauretania⁸ and in Athens.⁹

¹Pliny, N.H. 36, 194.

²Dessau, Inscr. Lat. 1, 1224 b: Mavortii. | Q. Flavio Maesio Egnatio Lolliano | c.v., q.k., praetori urbano, auguri publico populi Romani Quiritium, cons. | albei Tiberis et cloacarum, cons. operum|publicum, cons. aquarum, cons. Camp.|comiti Flaviali, comiti primi|ordinis et proconsuli provinciae Africae|regio clivi vitriari sive vici turari | patrono dignissimo.

³Itin. Ant.: de Italia in Gallias. Item a Mediolano per Alpes Graias. 345, 2: Vitricium. Cod. vitritium C, vitridium J. L. N. XX R. cf. 347, 5. Item a Mediolana per Alpes Penninas. 351, 2: Vitricio. "Cod. vitritio C, vitracio o q, vitricia P."()

⁴Graesse, Orbis Latinus, ed. 2, 317.

⁵Pliny, N.H. 36, 194.

⁶Strabo, 4, 5, 3: καὶ ὅλα σκεύη καὶ ἄλλος ἕρωπος τοιούτος.

⁷C I L XIII, 1, 1, 2000.

⁸C I L VIII 9430

⁹I G III 3436.

G. Evidence for the Importance of the Trade

In Greek and Latin there is no reference to the manufacture of glass in Greece with the exception of the glass-maker at Athens in Christian times.¹ As a foreign product, its nature was not sufficiently understood to prevent it from being confused with other substances. At first it was a rarity in Greece, and its value among other peoples is shown by its classification with precious metals and its use by those of high rank. The author of the book of Job² in praising wisdom says that "gold and glass cannot equal it," and classes glass with gold, silver, onyx, sapphire, coral, crystal, topaz, and rubies. Aristophanes³ speaks of the use of glass and gold cups at the Persian court. Glass had its place at the banquet of Ptolemy Philadelphus.⁴ In Epinicus⁵ King Seleucus is represented as drinking from a goblet of molten stone, *i. e.*, glass. However, as early as the fifth century, B.C., glass was sufficiently familiar to be used as a standard of comparison for transparent objects (see above page 50). In the fourth century Pausias painted a figure drinking out of a cup of highly transparent glass.⁶

Yet it was not until the beginning of the Roman empire that we know much about glass. Strabo⁷ gives the first detailed

¹ See above, p. 81.

² Job, 28, 17: οὐκ ἴσωθήσεται αὐτῇ χρυσίον καὶ ὄλος.

³ Ach. 94

⁴ Athen. 5, 199 F.

⁵ Athen. 10, 432 C.

⁶ Paus. 2, 27, 3: γέγραπται δὲ ἐνταῦθα καὶ Μέθη, Παυσίου καὶ Τούτο ξέργον, ἐφ ὑαλίνης φράλης πίγουσα. οὗδοις δὲ καὶ ἐν τῇ γραφῇ φράλην τε ὑαλού καὶ δι' αὐτῆς γυραῖκὸς περότωπον.

⁷ Strabo, 16, 758.

information about its manufacture in Egypt, Rome and Gaul. Then comes Pliny's¹ history of glass, which is the only one in antiquity with the exception of portions of Isidor's Origines² which closely follow the Natural History. Pliny not only tells of the traditional origin, the methods and places of manufacture, but he also describes valuable imported pieces. Since the Romans had their own factories, it is not strange to find the poets of the first and following centuries frequently mentioning glass. The adjective also was employed very often to express transparency, brightness, clearness, and possibly greenness.³

Even though glass became very common and cheap,⁴ there were still objects of glass which could be classed with the precious metals. Many of these seem to have been imported, especially from Egypt. Mention has already been made of the use of glass by the Egyptians in trading with the West Africans and peoples about the Red Sea. But since Rome herself produced quantities of excellent glass, that imported was probably only of exceptionally fine workmanship. The church naturally condemned such luxuries.⁵ The importance of the industry was sufficient to induce the Roman government

¹ N. H. 36, 190 ff.

² Orig. 16, 16.

³ Blümner, Farbenbezeichnungen bei den röm. Dichtern, 217 ff.

⁴ Strabo, 16, 758; Petron, 50: ignoscetis mihi, quod dixero: ego malo mihi vitrea, certe non olunt. Quod si non frangerentur, mallem mihi quam aurum; nunc autem vilia sunt. Treb. Poll. Gallien. 17, 5: bibit in aureis semper poculis aspernatus vitrum, cum diceret, nil esse communius.

⁵ Clemens Alex. Paedag. 2, 3, 35; 2, 4, 39.

to raise revenues by levying a duty on imported wares,¹ and to grant the workers in glass, as artists who deserved a special consideration, certain exemptions.²

¹Vopisc. Aurelian. 45. Lamprid. Alexander Severus, 24: bracariorum linteonum vitrariorum pellionum claustrariorum argentariorum aurificum et ceterarum artium vectigal pulcherrimum instituit ex eoque thermas et quas ipse fundaverat et superiores populi usibus exhiberi.

²Cod. Theod. XIII, 4, 2. Cod. Just. X, 66, 1.

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